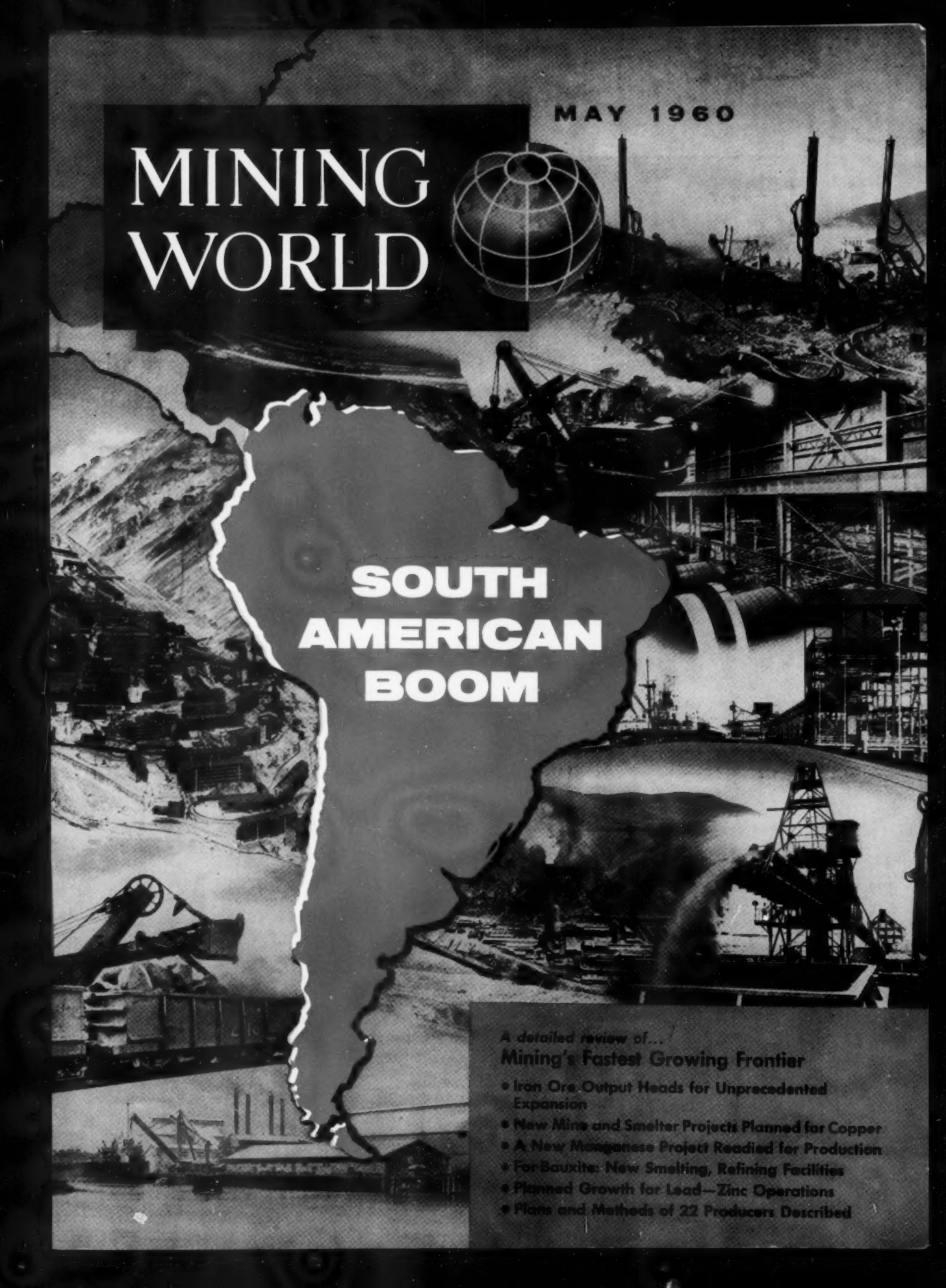
MAY 1960

MINING WORLD



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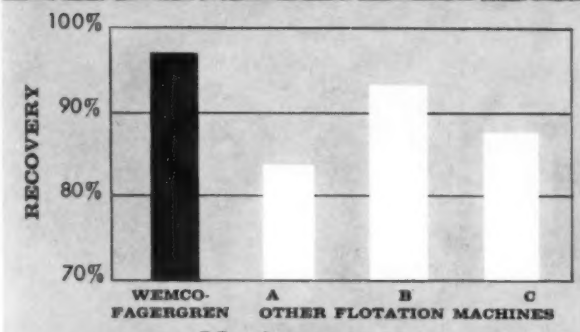

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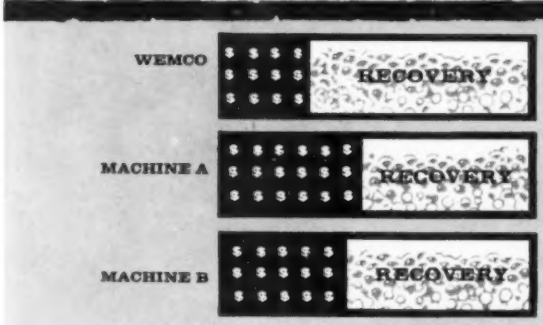

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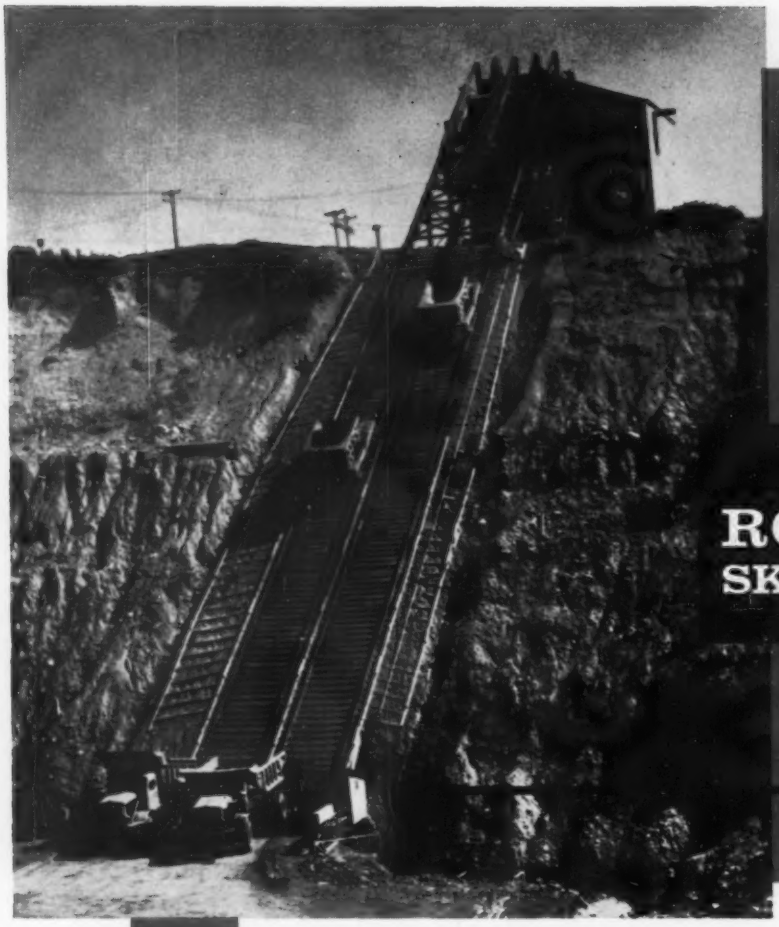

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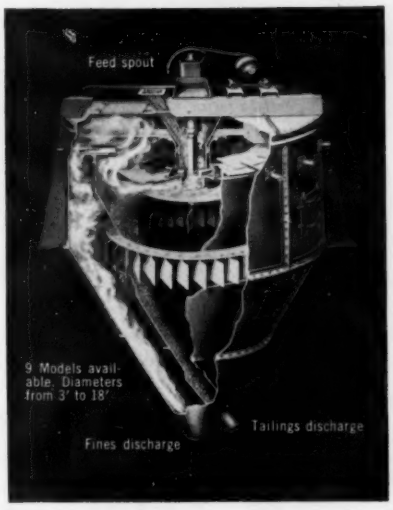

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New Type Engineer

"I believe that there is a very great need for better trained engineers," says Charles M. Brinkerhoff, president, The Anaconda Company. This is a challenge for the engineering educators to revamp curricula to meet the ever increasing trend from underground to open pit mining.

To accomplish this Mr. Brinkerhoff recommends accelerated education with the year divided into three four-month-long semesters. After three years a degree of "Engineer" could be achieved. Then, on a postgraduate basis of an additional two years, an advanced degree would be given for specialists in the field of advanced geology, metallurgy, ore dressing, chemistry, and automation. These would be trained specialists capable of developing new plant techniques and learning how to use the new tools which modern science is providing.

Note that no greater emphasis would be placed on the actual mining phase than is done today. Fewer underground mines and the growth of larger pits means fewer opportunities and research challenges for actual mining.

Engineering courses should also include the entire field of metals, non-metallics, fuels, their recovery from the natural state, and preparation for market. The new engineer should be trained in foreign languages, in cost accounting, and financial control.

John Bogert Joins Staff

MINING WORLD-WORLD MINING announces that John R. Bogert has joined the editorial staff as Field Editor. Mr. Bogert brings over 11 years of varied mining, geological, and exploration experience that he has gained throughout the United States and Latin America.

Born and raised in Wilmington, Delaware, he received his BS degree in geology from Muhlenberg College in 1947, and later earned an MA degree from the University of Delaware.

His first experience in mining was at the Chuquicamata open-pit in Chile. By 1950 he was in charge of an exploration team in the Venezuelan iron-manganese region. From 1952 through 1956 he traveled almost continually examining prospects throughout Latin America and the United States for the Kennecott Copper Corporation and the Cerro de Pasco Corporation. Most recently John was Chief Geologist for the National Lead Company in Buenos Aires, Argentina, and made extensive studies of the mineral resources of the Argentine-Chilean Andes.

John has contributed interesting articles to MINING WORLD-WORLD MINING in the past, and with his broad experience and extensive knowledge of Latin America, is a welcome staff addition. Mining camps in the United States will be seeing a lot of John as he reports the news of the industry.

Drillmaster Does Double-Duty at Anaconda's RAINBOW VEIN

This one heavy-duty rig is used for both rotary and percussion drilling in varying rock formations

To drill blast holes through radically changing rock formations at the Anaconda Company's Rainbow Vein open pit zinc mine in Butte, Montana, the F & S Contracting Co. has had to use both rotary and percussion drilling. And *both* jobs are being done to excellent advantage with the versatile I-R Drillmaster shown above. For much of the overburden, roller-cone rotary bits are used. And in the harder layers overlaying the deep, narrow Rainbow Vein, which contains zinc and lead sulphides with values of gold and silver, the rotary bits are replaced with an I-R Downhole Drill for percussion drilling, using the same rotary head for drill rotation. Holes are drilled 42 ft deep with 6¼" bits on 15 to 18 ft spacing and loaded with fertilizer grade ammonium nitrate with diesel oil.

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GOVERNMENT ACTION AND REACTION AFFECTING MINING

Favorable Lead-Zinc Legislation Considered Unlikely . . .

Congressional sources indicate there is little likelihood that any legislation to aid the lead-zinc industry will be passed at this session. The Administration has reported unfavorably on the Kerr-Edmondson bill; and assistant secretary Royce Hardy of the Interior Department, at recent hearings before the House Interior Committee's mining subcommittee, stated that, in effect, these bills to aid the small mine segment of the industry are class legislation; further, that the full effects of the quota system have not yet been felt.

The Senate Interior Committee is marking time on the Kerr bill, and will depend largely upon the House Interior Committee's action. The Senate appears to be somewhat tired of passing bills to aid mining, only to have them rejected in the House. There is also the question of the three industry segments—large mines, small mines, and smelters—getting together on a program. If the Kerr small mines bill does not move, and it looks as though it would not, the chances for any lead-zinc legislation during this Congress seem slim indeed. ■

Colmer Bill Should Be Watched; Worse Than P. L. 167 . . .

Attention should be called to H. R. 11194 by Representative Colmer and a number of similar bills which appear to go beyond Public Law 167 of July 23, 1955. There is small probability that the bill will move at this session of the Congress, but it was referred to the House Committee on Agriculture.

This committee, it will be remembered, tried to write a much stiffer law than P. L. 167, some years ago, and well might amend H. R. 11194 to the further disadvantage of the mining industry. The bill directs that the national forests shall be administered for outdoor recreation, range, timber, watershed, wildlife, and fish purposes, although there is a reservation on the mineral aspects.

H. R. 11194 could turn out to be a very dangerous measure, and it is supposed to have Administration support. ■

Patented Placer Claim Mill Sites Authorized . . .

Patenting of mill sites not to exceed five acres adjacent to placer mining claims is now possible through legislation signed by President Eisenhower on March 18. The bill in question was S. 2033 which now becomes P. L. 390.

Producers in the nonmetallic fields had urged this amendment to the mining laws since they had experienced difficulty in obtaining the necessary lands for milling, crushing, and beneficiation facilities. No legitimate means existed under the basic law, they said, whereby the necessary land could be acquired.

The amendment provided by P. L. 390 permits a mill site of not more than five acres located on nonmineral public land to be patented simultaneously with the mineral lands embraced within a placer mining claim, with payment at the rate applicable to the purchase of the mineral land within the claim. ■

Forest Service Requests Multiple Use Policy Statement

Mounting demands for the use of the national forests—and the undue pressure being exerted for additional wilderness legislation—has led the Forest Service to seek enactment of a bill which will declare multiple use of the national forests as the definite policy of Congress. Previous planning had expected to accomplish this purpose by an amendment to the Wilderness Bill.

The Forest Service proposal is contained in S. 3044 and H. R. 10465, identical bills, "To authorize and direct that the national forests be managed under principles of multiple use and to produce a sustained yield of products and services." Specifically mentioned as multiple uses are outdoor recreation, range, timber, watershed, wildlife, and fish purposes. The bill also stated that nothing in the measure "shall be construed to affect the authority of the Secretary of the Interior provided by law with respect to mineral resources." ■

President Makes No Commitment On Copper Tariff . . .

Assurances have come from the White House regarding any commitments President Eisenhower might have made, during his Latin American tour, with regard to a tariff on copper. At that time, press reports had stated that he promised Chile's president that he would "study the possibility of eliminating the import tax on copper."

When that report came to the attention of Arizona's Congressman John J. Rhodes, Rhodes immediately contacted Bryce Harlow, deputy assistant to the President for Congressional Affairs. He asked for a clarification of the matter, since the current tax (1.7 cents per pound) is not sufficient to equalize the differences in cost

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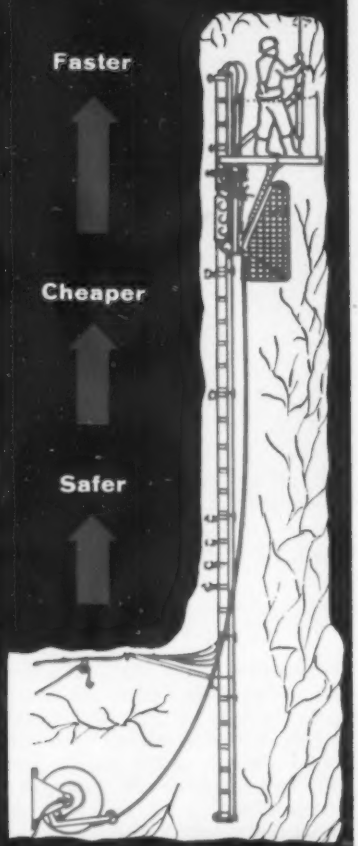

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A MINING WORLD "BLUE RIBBON" AWARD WINNER

between the United States mines with their high wages and the Chilean mines with their low wages. Domestic producers, he said would not welcome any action which would result is making their position more difficult.

Harlow replied that "the President made no commitment whatsoever. The matter was just discussed in general terms." ■

Treasury Not Concerned About Gold Outflow . . .

Alfred H. Van Kleinperer, assistant to the Secretary of the Treasury, assures us about the outflow of gold as follows:

"Of course, today's gold stock of the U.S. is a rather comfortable reserve. *As long as we do not have to be concerned* (emphasis supplied) about any unusual or unexpected demands on our gold supply the present ratio of gold to foreign dollar holdings is an ample one. After all, it is convenient for foreigners to keep their reserves in a first-class *convertible* currency where they can earn a good return on their funds, *as contrasted to gold* where safe-keeping and other costs rather than income are incurred. Also, large operating balances are required in connection with their trade with the U.S. and it is thus really not in the interest of the owners to withdraw these balances and convert them into gold. The existence of large liquid dollar holdings by foreigners attests to the confidence which other governments and their citizens have in our currency."

Let's hope that nothing starts a run on the bank! ■

Objections Raised To Manganese Barter . . .

Removal of manganese from the Department of Agriculture's barter list is being requested by members of the American Manganese Producers Association. In letters to their Senators and Representatives they are critical of the tentative plans of the Agriculture Department to exchange surplus farm commodities for manganese from India.

They also call attention to the fact that imports of manganese ore into the United States during 1959 amounted to 2,442,183 short tons, with 1,031,568 tons of that total coming from Brazil. It is their understanding that the major portion of the Brazilian manganese came from a mine whose development was financed by the United States through Import-Export Bank loans. They are asking what part of this tonnage from Brazil was purchased by the government and went into the government's stockpile and how long the government will continue to purchase.

It All Depends Upon Whose Subsidy . . .

Although the Administration claims to be against subsidies (and certainly is against subsidies for the mining business, including gold mining), a willing ear has been lent to an application by Capitol Air Lines for a return to subsidy mail operations "because of abnormal factors." Capitol requested an immediate 22.5 cents per revenue plane mile rate to supplement its present mail service. This will increase the company's revenue by $12,949,000 a year.

A subsidy in that amount would have really put the domestic manganese producers in business.

Bid Invitation For Asbestos Is Issued . . .

The General Services Administration, on orders from the Office of Civil and Defense Mobilization, has issued invitations to bid on 250 short tons of crude asbestos, chrysotile Grade No. 1, and 250 short tons of Grade No. 2.

The asbestos must be equal to or better than that mined in Southern Rhodesia at the Shabanic Mines. This was the specification that the stockpile boys and government purchasing agents dreamed up quickly during the urgencies of World War II. Since then, however, an elaborate testing schedule has been developed to determine conformity. However, OCDM still is relying upon the opinions of users before letting the bids.

The asbestos is to be of domestic origin, which just about restricts it to that produced in Arizona. The specifications are so much more rigid than those for the original GSA purchase program that it will be interesting to see how many producers can meet them.

A form showing qualifications of an individual who wants to bid must be filled out. Of course it is not unusual to require a statement of financial responsibility, but this one looks as though GSA had acquired a psychologist. Among the pertinent and impertinent questions they want answered is whether or not you are single- married, divorced, or widower-widow!

Power for Toquepala

...an example of global engineering by Brown Boveri

BROWN BOVERI

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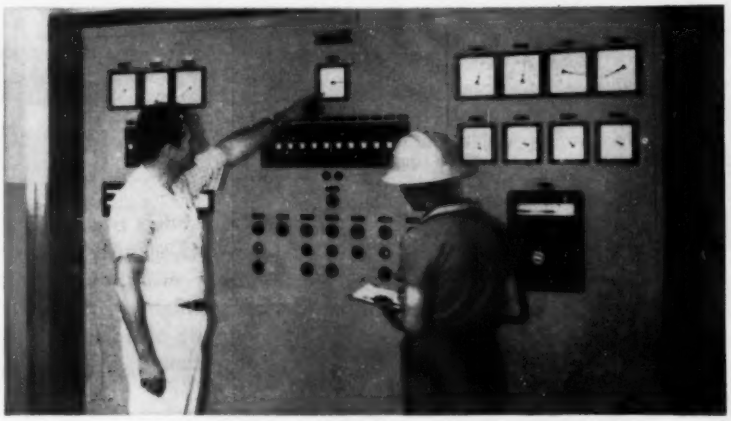
In planning the gigantic Toquepala project, the combine headed by American Smelting and Refining Company and its consulting engineers, Stearns-Roger Mfg. Company, turned naturally to Brown Boveri for the power supply. In Peru, nearly all large turbo-sets are Brown Boveri-built and our company there is an established service organization with resident engineers available anywhere in the country.

Look where you will the story is the same – be it gas turbines in Arabia, rectifiers in Rhodesia, switchgear in India, a turbo-compressor in Pakistan, power line communications in the Congo or mining operations in Arizona or Toquepala–it's routine for Brown Boveri.

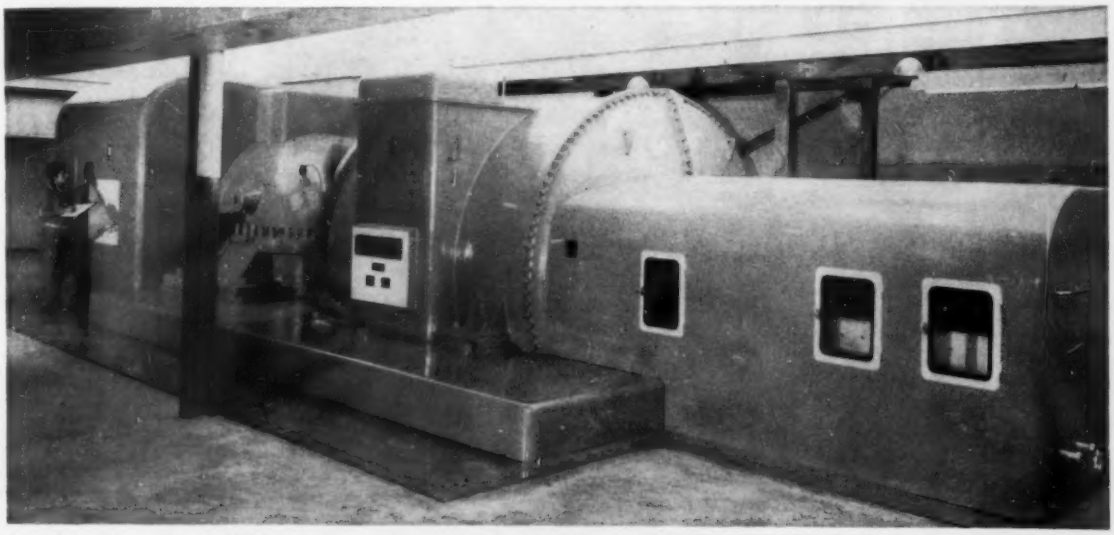


Control panel for one of the Brown Boveri turbine-generators.

Over 80% of the production of Brown Boveri's great Swiss works is exported and we maintain production facilities, sales and engineering offices in over 65 countries with close to 70,000 people on our payroll.

If you are thinking of an overseas project of any kind, we invite you to draw on this unique experience in global engineering. We think you'll be glad you did.

Brown Boveri builds steam and gas turbines, boilers, condensers, generators, transformers, switchgear, rectifiers, motors and complete rolling mill drives, compressors, electric furnaces, betatrons, induction heating equipment, communication equipment.



One of two Brown Boveri 20/22 MW Preferred Standard steam turbine-generators at Toquepala copper smelter in the Peruvian Andes. Generators are 60 cycle, 3600 rpm.

They power huge electric stripping shovels, smelter blowers, crushers, separators and other heavy mill equipment . . . and two company housing projects.

This is the biggest thermal station in Peru. Brown Boveri also supplied the two main condensers, the dump condenser and the air ejectors.

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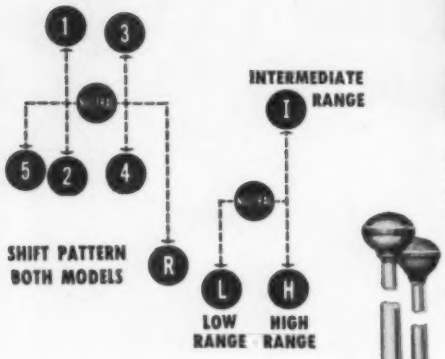

MODEL 15-G-1120

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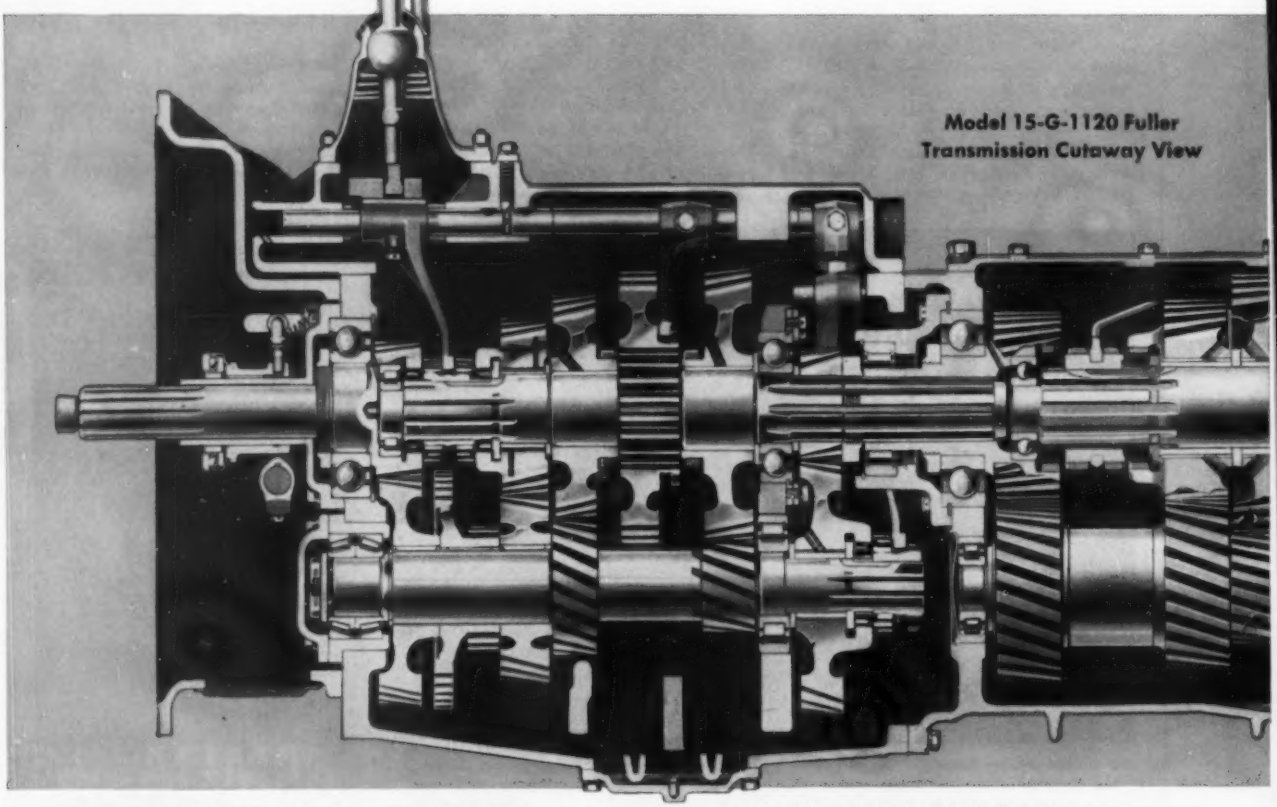

Model 15-G-1120 Fuller Transmission Cutaway View

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4. Weight reduction obtained by eliminating support brackets, joints, cross members and a propeller shaft.

For full details on the Fuller 15-G-1120 and 15-H-1120 Transmissions, ask your dealer or write Fuller Manufacturing Company.

Model 15-G-1120: Standard Gear Ratios

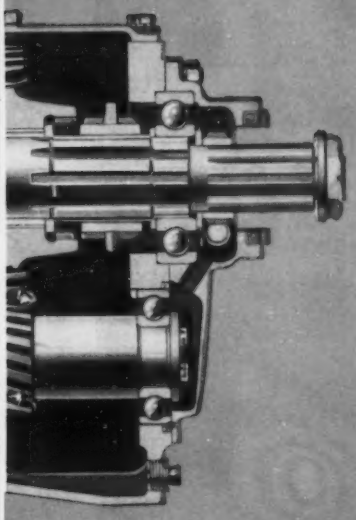
SPLITS—OVER-HIGHWAY				LOW RANGE—OFF-HIGHWAY		
Speed	Split	Ratio	% Step	Speed	Ratio	% Step
10th	O'Drive-High	.636		5th-Low	1.33	
			33			
9th	O'Drive-Int.	.844				57
			19			
8th	Direct-High	1.00		4th-Low	2.09	
			33			
7th	Direct-Int.	1.327				76
			32			
6th	3rd-High	1.76		3rd-Low	3.68	
			33			
5th	3rd-Int.	2.32				86
			41			
4th	2nd-High	3.27		2nd-Low	6.83	
			33			
3rd	2nd-Int.	4.33				100
			51			
2nd	1st-High	6.54		1st-Low	13.67	
			33			
1st	1st-Int.	8.68				

Model 15-H-1120: Standard Gear Ratios

SPLITS—OVER-HIGHWAY				LOW RANGE—OFF-HIGHWAY		
Speed	Split	Ratio	% Step	Speed	Ratio	% Step
10th	O'Drive-High	.636		5th-Low	1.68	
			33			
9th	O'Drive-Int.	.844				57
			19			
8th	Direct-High	1.00		4th-Low	2.64	
			33			
7th	Direct-Int.	1.327				76
			32			
6th	3rd-High	1.76		3rd-Low	4.65	
			33			
5th	3rd-Int.	2.32				86
			41			
4th	2nd-High	3.27		2nd-Low	8.63	
			33			
3rd	2nd-Int.	4.33				100
			51			
2nd	1st-High	6.54		1st-Low	17.27	
			33			
1st	1st-Int.	8.68				

Optional Gear Ratios: Models 15-G-1120, 15-H-1120

Overdrive: .85, optional at extra cost
Overdrive: .74
Reverse: 5.06



Subsidiary of EATON Manufacturing Company

a million yds. a month . . .

moved by Euclid "Twins"

At a mining operation in central Wyoming, a fleet of 18 Euclid scrapers is removing overburden from uranium ore at a rate of a million cu. yds. a month . . . nearly 21 million cu. yds. will be moved to uncover the ore body. It's a big, tough job to move that quantity of heavy sand over a mile of adverse grades up to 12%.

Maco Construction Co. of Rawlins, Wyoming, contractor on this stripping project, bought 12 Twin-Power "Euc" Scrapers of 24 yd. struck capacity to maintain high speed production. With two engines and all-wheel drive, these scrapers have the power and traction needed to move big loads up steep grades from pit to dumping area. Twin-Power is paying off in the big performance of Maco's five TC-12 Euclid crawler tractors, too—they're used for push loading this all-Euclid fleet of scrapers.

Wherever big tonnages must be moved on mine, quarry, industrial and heavy construction work, Euclid equipment provides more work-ability and better return on investment. The dealer in your area will be glad to supply facts and figures on Euclid rear-dump and bottom-dump haulers, scrapers, crawler tractors and front-end loaders.

EUCLID Division of General Motors, Cleveland 17, Ohio

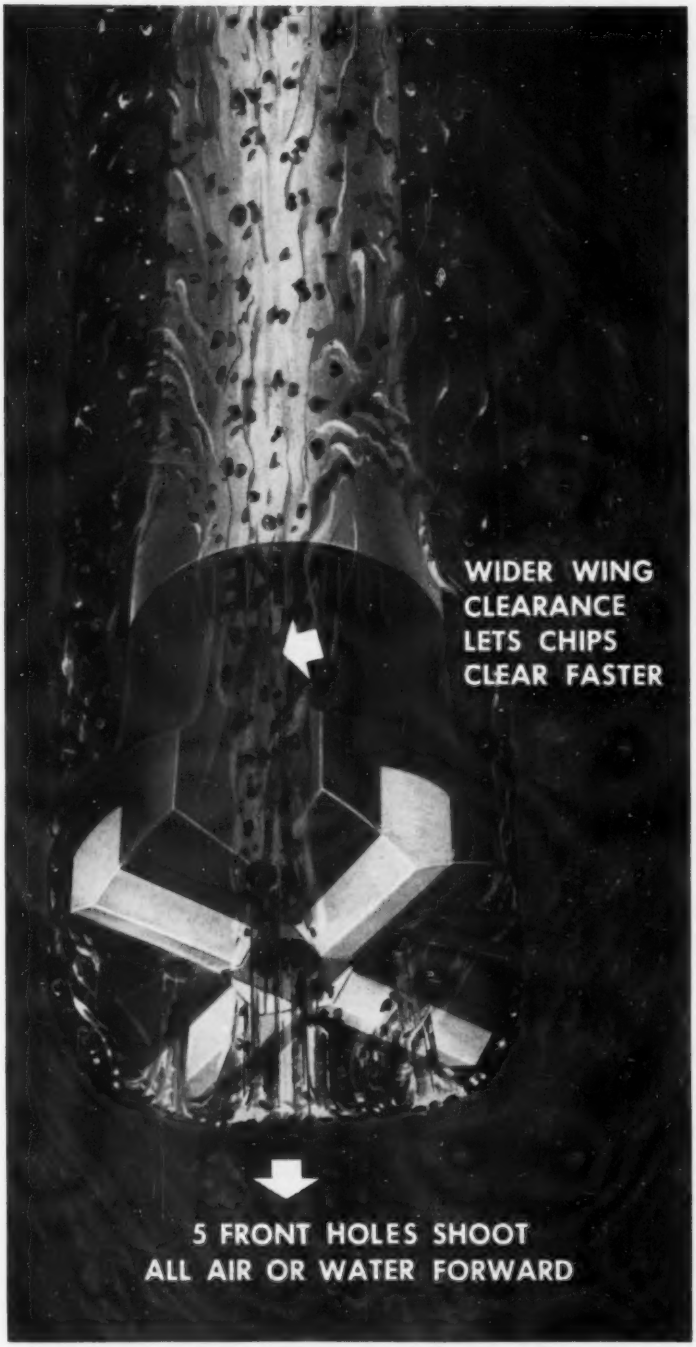
Big power and big capacity pay off in big production . . . Euclid TC-12 Crawler Tractor has 2 engines that deliver 425 net h.p. . . . "Twin" Scraper of 24 yd. struck capacity also has 2 engines (563 total h.p.) and all-wheel drive with separate Torqmatic Drives for each axle.

GM GENERAL MOTORS EUCLID

EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE

For drifters, sinkers and stopers...



TIMKEN®
removable rock bits

TIMKEN® THREADED BIT CLEARS CHIPS FASTER, KEEPS DUST DOWN

THE illustration at left shows how this Timken® threaded carbide insert bit clears chips faster, keeps dust down in mines. The 5 front holes shoot water directly against the rock, wash chips back faster. The deeper, wider wing clearance helps speed chip removal. You drill rock, not chips. And this improved water circulation, by keeping dust down, helps make mining safer.

This fast wash back ends drill steel clogging, protects bit skirts against damage. And the special analysis carbides have greater shock-and-wear resistance. They can be reconditioned many times. Improved thread contact minimizes breakage.

For more hole-per-bit, use this Timken threaded carbide insert bit. Get full details in free brochure. Write: The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable:"TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

FOR OTHER TOUGH DRILLING JOBS

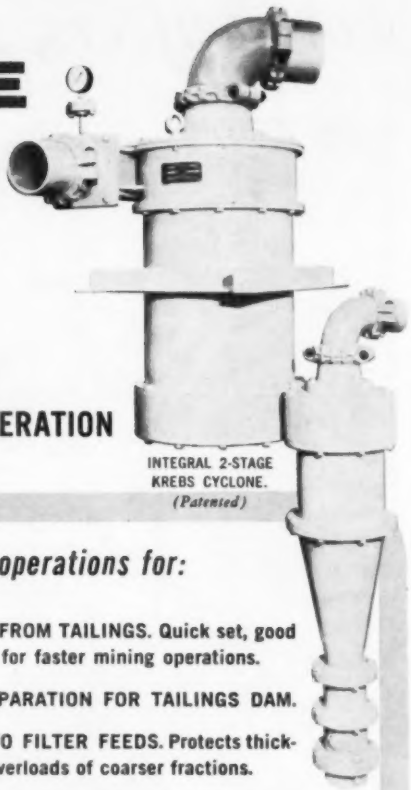
Improved Timken all-steel multi-use bit, with correct, controlled reconditioning, gives you lowest cost per foot-of-hole when you can drill out full increments of steel.

Timken tapered socket carbide insert bit is removable for full steel life, tapered for more secure union. Has same frontal features as threaded bit. Gives you bit removability with one-piece steel strength!

KREBS CYCLONE

...the most effective classifier for a wide range of applications

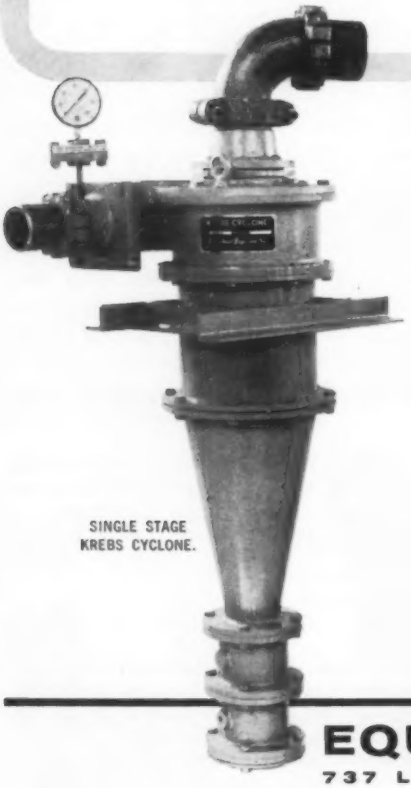
- ✓ LOW INITIAL COST
- ✓ REDUCED MAINTENANCE
- ✓ GREATER RUNNING TIME (No grind-out required)
- ✓ METALLURGICAL GAINS OFTEN OF MAJOR CONSIDERATION



INTEGRAL 2-STAGE KREBS CYCLONE. *(Patented)*

PREFERRED by a rapidly expanding number of large operations for:

- CLOSED-CIRCUIT CLASSIFICATION IN PRIMARY MILLS.
- SECONDARY MILLING CIRCUITS.
- CONCENTRATE REGRIND CIRCUITS.
- PRECISION DE-SLIMING.
- MINE FILL FROM TAILINGS. Quick set, good percolation for faster mining operations.
- BERM PREPARATION FOR TAILINGS DAM.
- ADJUNCT TO FILTER FEEDS. Protects thickener from overloads of coarser fractions.
- DESANDING MINE WATER. Reduces pumping maintenance substantially.
- OTHER SPECIAL APPLICATIONS.



SINGLE STAGE KREBS CYCLONE.

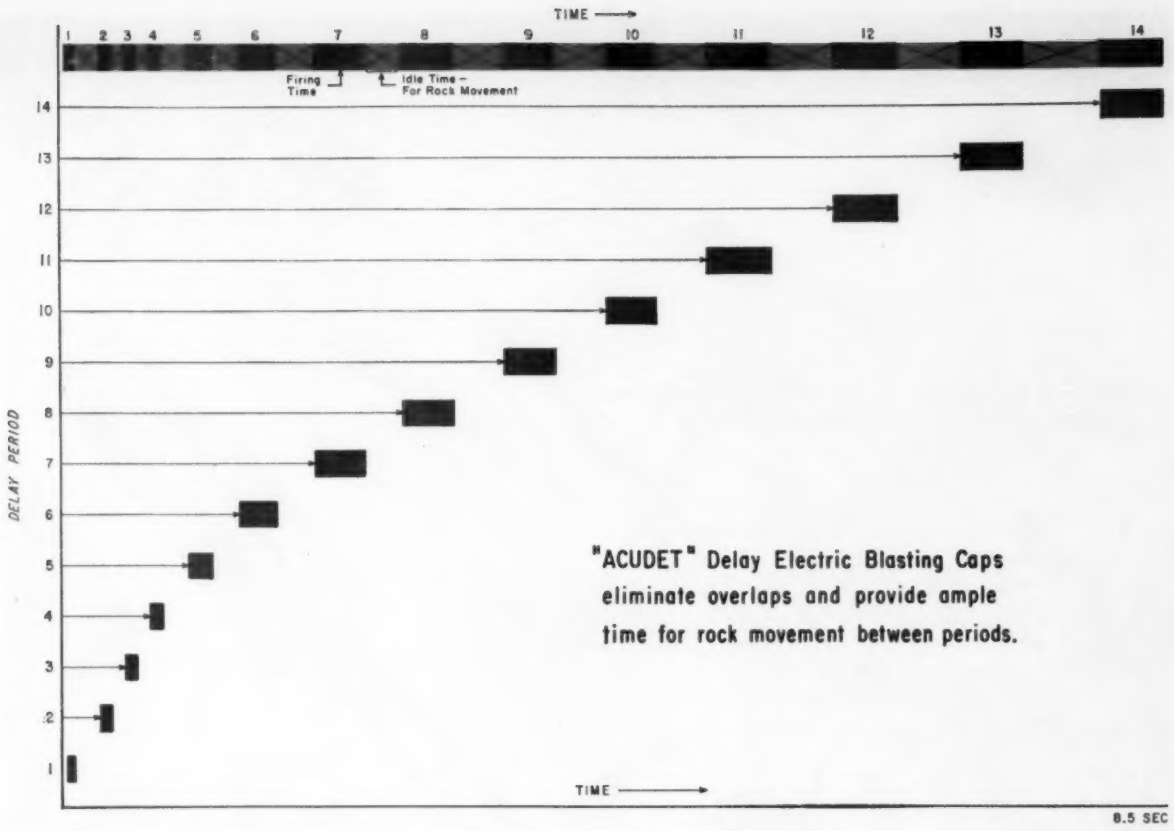
EQUIPMENT ENGINEERS INC. HAS DEVOTED ITS ENTIRE EFFORTS for over 11 years to the design and manufacture of cyclones adapted to individual plant operations.

THE PILOT PLANT AT PALO ALTO is equipped for full-scale testing programs. Results are correlated with a large tabulation of data from other tests and subsequent installations and accurate performances are predicted. This work often leads to economies and metallurgical gains.

THESE FACILITIES ARE AVAILABLE TO YOU for the study of your classification problems. Inquiries invited.

EQUIPMENT ENGINEERS, INC.

737 LOMA VERDE AVENUE · PALO ALTO, CALIFORNIA



New Du Pont Acudet® Delays... the first delay electric blasting caps ever to give you a definite time gap to allow rock movement between periods

Fire . . . pause . . . fire . . . pause . . .

Here for the first time are delay electric blasting caps that are made to fire with a definite time gap between the slowest cap of any period and the fastest cap of the next highest period. THEREFORE overlap is eliminated and time is provided for rock movement between periods.

You have never before been offered this kind of accuracy in delay blasting control.

Du Pont Acudet Delays are manufactured by mechanical assembly to closer timing tolerances than ever before possible, which assures a positive time gap of 1/10 to 1/2 second between periods through the entire series of 14 delays.

The timing of each period and the length of the time gap between periods have been carefully selected to give optimum blasting results under all conditions. For instance, the time gap between the first and second delays is made long enough to allow the rock from the cut to move out of the way before the first relievers go.

In the few months that these new caps have been in the field, Du Pont Acudet Delays have been widely and enthusiastically accepted. Experience in a variety of operations has confirmed these advantages:

1. **Less bootleg**—more advance per round
2. **More uniform fragmentation**—easier mucking
3. **Less overbreak**—better shearing action
4. **Shorter shells**—easier to make primers
5. **Aluminum shells**—corrosion resistant
6. **First period fires in 1/40 second**—no need for special timing or circuit breaking equipment.

Like all other Du Pont Electric Blasting Caps, Acudet Delays are mechanically assembled with nylon plastic insulation, rubber plug closures, and shielded shunts.

Ask your Du Pont representative or distributor *now* for detailed information on the phenomenal accuracy of Acudet Delays and what this means for you in your operation.

Call him direct or write to Du Pont, Explosives Department, 6440 Nemours Building, Wilmington 98, Delaware.

DU PONT REG. U. S. PAT. OFF. **EXPLOSIVES**

BETTER THINGS FOR BETTER LIVING... *through Chemistry*

Make your mine openings self-supporting with

CF&I Rock Bolts

CF&I Rock Bolts reduce the need for costly and clumsy mine timbering. Mine openings may be smaller or the space saved will allow freer, more efficient movement of machinery. Ventilation is improved, too.

But most important, CF&I Rock Bolts with the Pattin Shell provide safe and sure support for walls and roofs. The double expansion of the Pattin Shells makes continuous contact along the entire length of the shell. You get maximum anchorage in any type of rock. The Pattin design also provides maximum resistance to load with minimum displacement of the shell. Mine records have shown that the use of CF&I Rock Bolts with lagging of Realock Metallic Fabric results in cost savings of about 35% over timbering. For complete information on threads, diameters, lengths, price and delivery, contact your local CF&I sales office.

CF&I also makes a complete line of 1" Wedge Type Rock Bolts, as well as ¾" expansion type slusher pins.

7811

OTHER CF&I STEEL PRODUCTS FOR THE MINING INDUSTRY

CF&I Grinding Balls • CF&I Grinding Rods • CF&I Mine Rail and Accessories • CF&I-Wickwire Wire Rope • CF&I Industrial Screens • CF&I Grader Blades

A 20-minute Rock Bolting color movie "Make Mine Safety" is available for showing at no charge, through the CF&I office nearest you.

MINING PRODUCTS

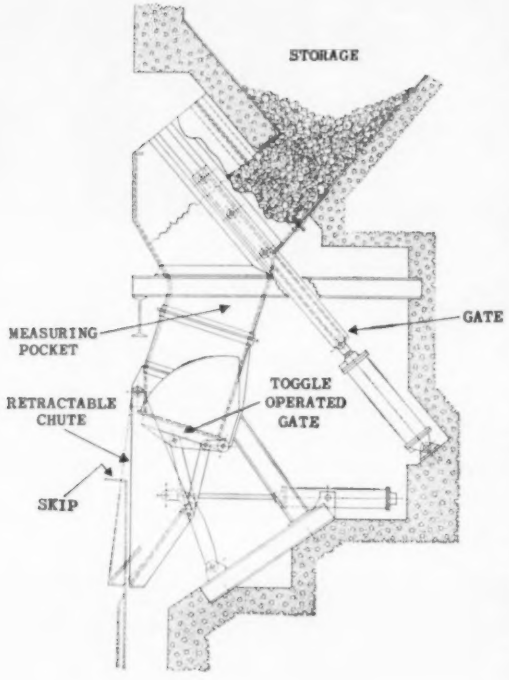
THE COLORADO FUEL AND IRON CORPORATION

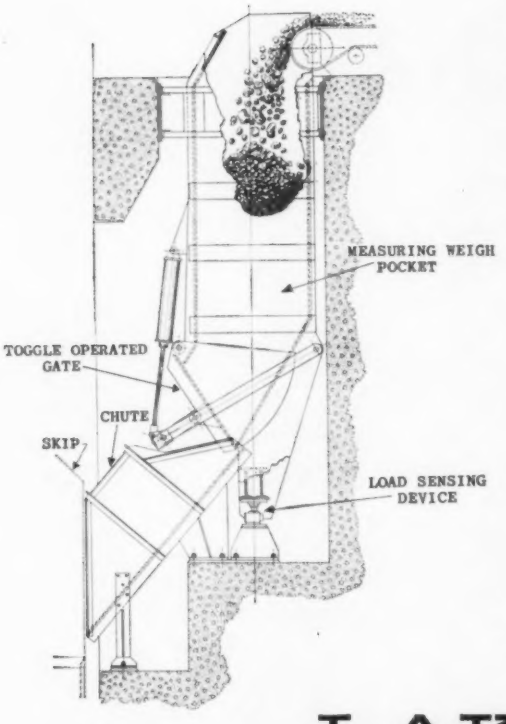
CF&I STEEL

In the West: **THE COLORADO FUEL AND IRON CORPORATION** — Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso • Ft. Worth • Houston Kansas City • Lincoln • Los Angeles • Oakland • Oklahoma City • Phoenix • Portland • Pueblo • Salt Lake City • San Leandro • Seattle • Spokane • Wichita

In the East: **WICKWIRE SPENCER STEEL DIVISION** — Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia

Automatic Skip Loaders





Patents Pending

NOW USED FOR HARD ROCK MINING IN MULTILEVEL OPERATIONS

MEASURED BY VOLUME SKIP LOADER

Upper cut-off gate is open, material from a storage bin above flows into the measuring pocket of skip loader. After a set time, the undercut type gate pushes up through the material. Any larger chunks above the gate will not impede the action of the gate . . . they will be floated to the top of the material flow line, which is governed by the angle of repose of the material.

The discharge gate between the measuring pocket and the skip is toggle operated for better flow and tight sealing when closed. Also, it conserves air required to operate the toggle gate. The weight of ore to be discharged actually aids in the opening of the gate once the linkage is past the center. Therefore, smaller cylinders can be utilized. Flow control with cam operated valves can be included so that gate action is smooth and operating impacts are virtually eliminated.

MEASUREMENT BY WEIGHT SKIP LOADER

This loader does not require the cutting off of load after material flow from the upper bins to the measuring pocket has stopped. A load sensing device causes the gate to close when the desired weight of load has been discharged into the measuring pocket.

This type of loader can be used in conjunction with other types of pocket feeding . . . conveyors, pan feeders, drum feeders or reciprocating plate feeders. When used with one of these feeders, the signal from the load sensing device shuts off a feeding mechanism when the measuring pocket has received the desired weight of material.

The automatic controls of both loading systems described above can be tied in with automatic hoist control to provide for a completely automated material hoisting system. In multilevel operation the complete system is actuated by one push button at the operating level. No other level can take over command of the skips without their being released at the level from which they have been operating. During operation from a given level, the loaders at other levels are rendered inoperative through interlevel interlocking control.

Lake Shore manufactures other loaders than those shown and can match the proper automatic loaders to your specific conditions.

LAKE SHORE, Inc.

IRON MOUNTAIN 1, MICHIGAN

ASEA'S NEW MINE HOISTS BREAK WORLD'S LOAD RECORD

ASEA's new multi-rope friction mine hoists for installation in one of the largest mines take an unbalanced load of 55 tons at a speed of 2760 feet per minute—twice the load of any known hoist at this record speed.

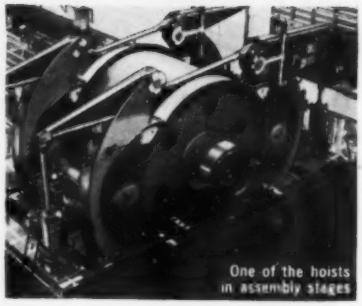
Here are two major advantages of these new mine hoists pioneered by ASEA for mine owners everywhere.

1 **MULTI-ROPE FRICTION DRIVE;** this enables a moderate sized pulley (length, 7'2", diameter, 12'2") to take a very high unbalanced load with ease.

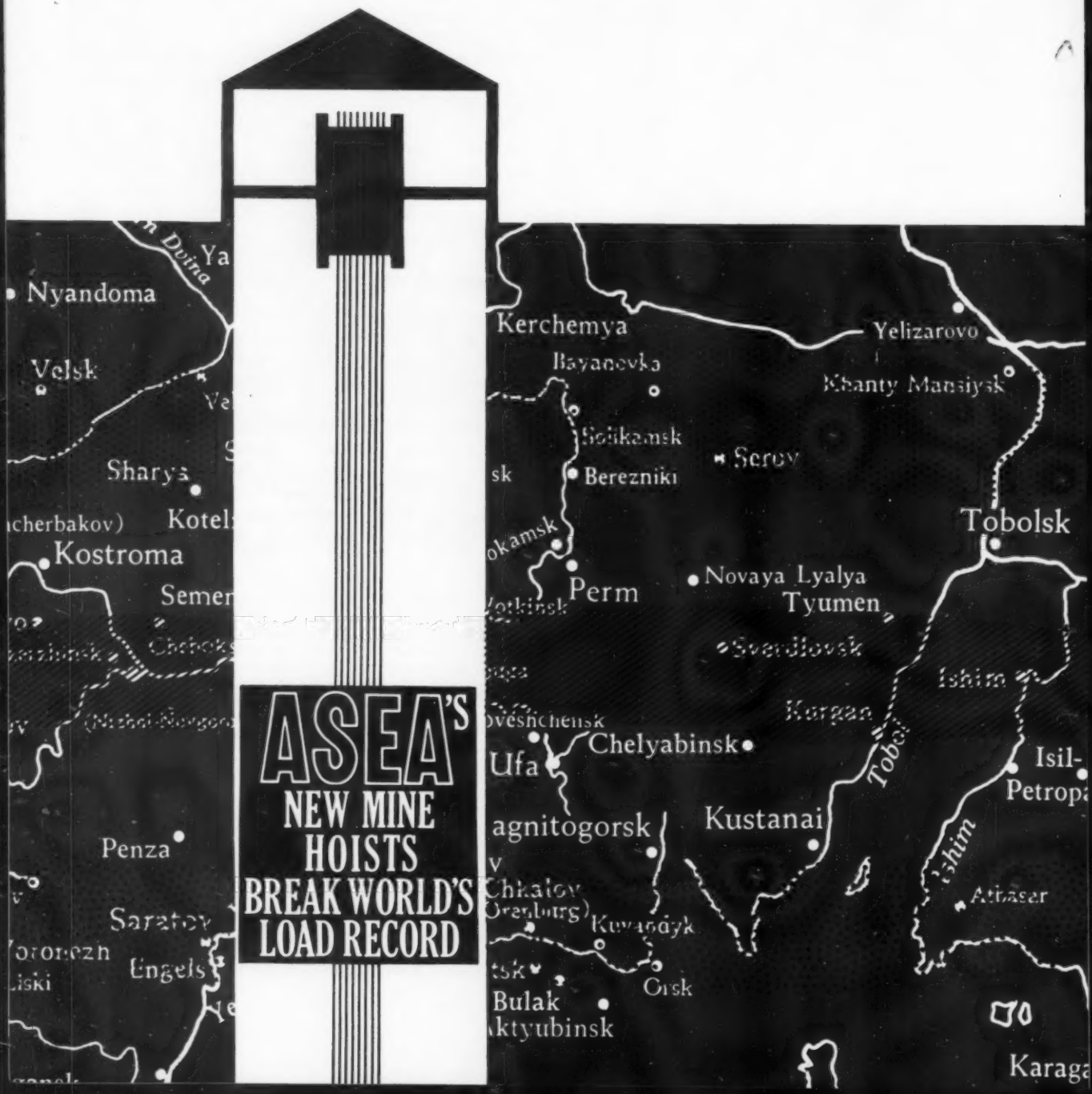
2 **FULLY AUTOMATIC OPERATION,** which can save as much as $30,000 a year per hoist at prevailing U.S. wage rates, assuming two-shift operation.

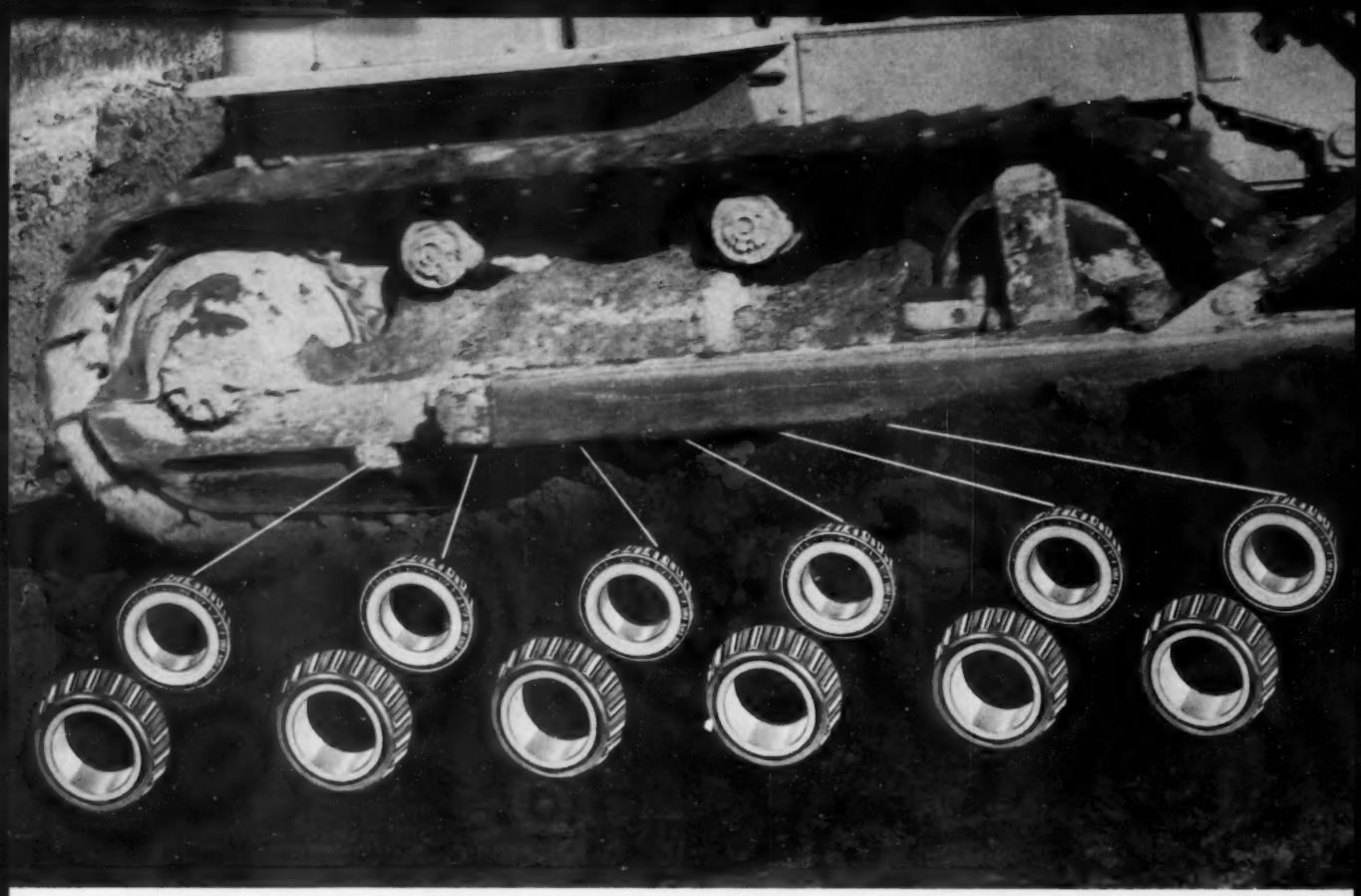
Make profitable use of ASEA design and engineering experience. Let ASEA save operating costs—in a big way just as it saves for 14 U.S. and Canadian mining companies. Write for literature to: ASEA ELECTRIC INC. 500 Fifth Avenue, New York 36, New York and 55 New Montgomery Street, San Francisco 5, California.

TECHNICAL DATA			
Hoisting	Double Skip	Hoisting speed	2760 ft. per min.
Hoisting capacity	1400 tons per hour	Number of ropes	8
Net load	55 tons	Rope Diameter	1¾"
Skip weight	44 tons	Diameter of Pulley	12'2"
Depth of shaft	3948 ft.	Length of Pulley	7'2"
		Motor output	12,000 h.p.



One of the hoists in assembly stages





MORE WORK POWER PER HORSEPOWER

Reduced friction through use of tapered roller bearings in all Allis-Chalmers crawler tractors makes the difference in work power and profit for you!

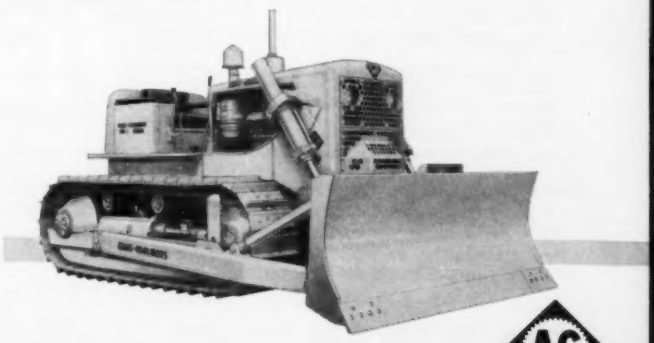
All Allis-Chalmers crawler tractors roll on tapered roller bearing truck wheels. Most others still use bushings.

Anyone who remembers his roller skating days knows the performance advantages of bearings over bushings. The difference between first and also-ran was in the wheel bearing. This friction-reducing advantage is the reason railroads all over the country have turned to *roller* freight.

The same principle applies to tractors except much more power is being wasted by friction-type plain bushings. It's one of the reasons the 99-hp HD-11, on tapered roller bearings, produces right alongside larger crawler tractors. Can you continue to pay for power that *never* produces—that gets "lost" in old-fashioned bushings?

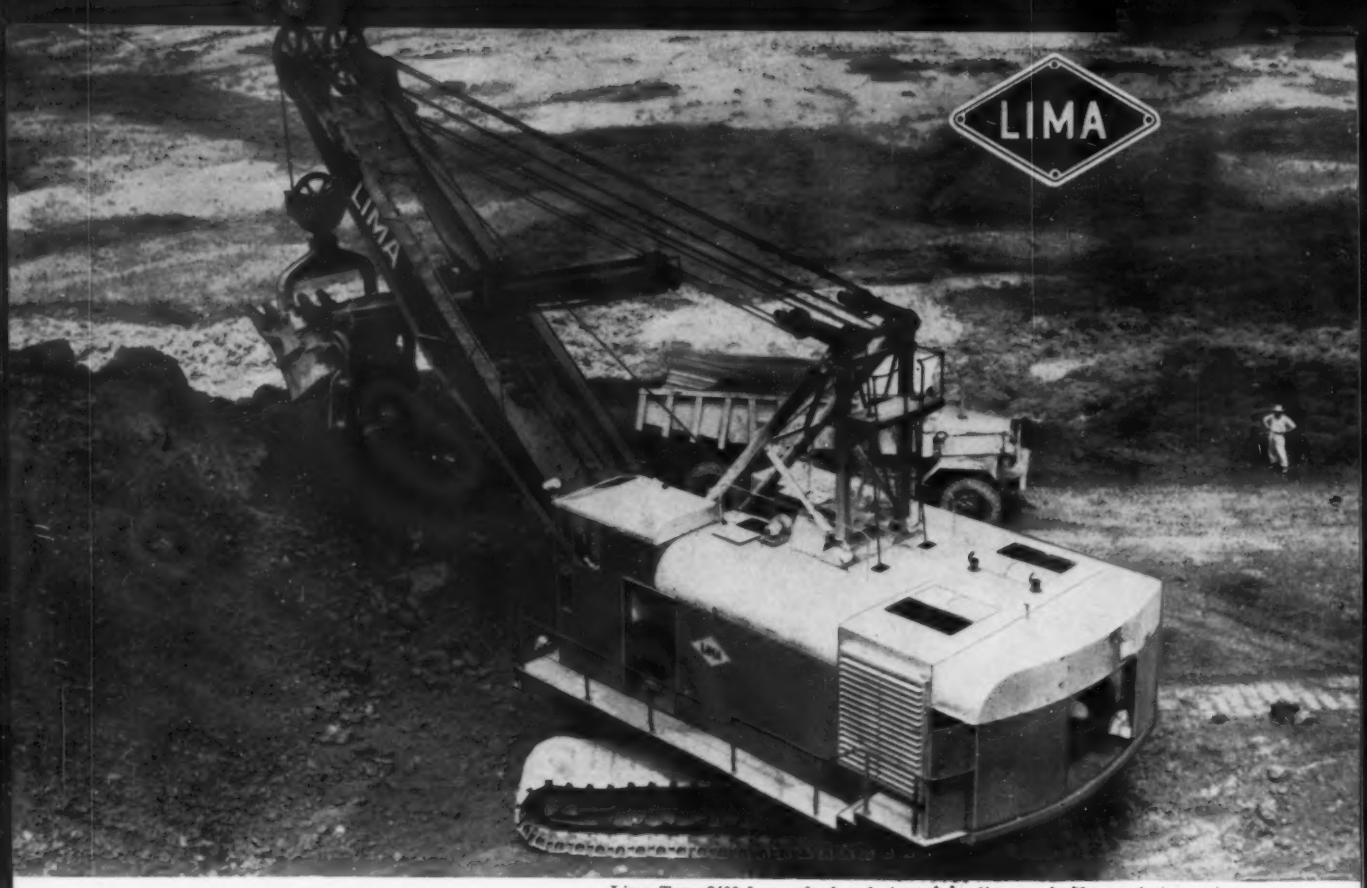
Your Allis-Chalmers dealer will be glad to discuss this and the many other advantages that keep the HD-11 on the go shift after shift with a minimum of maintenance.

Ask about the *toughest track ever built* . . . the *industry's healthiest engine* and *certified permanent lubrication.* Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.



move ahead with ALLIS-CHALMERS

...power for a growing world



Lima Type 2400 6-cu. yd. shovel at work loading ore in Venezuela iron mine.

THE LIMA TYPE 2400...
muscled for the big mining jobs

Quality does pay off. As hundreds of mining operators have found, Lima's extra engineering features and precision construction mean greater tonnages, higher profits.

When the going is tough, there is no substitute for these Lima Type 2400 quality features:

Crawlers are wide and long for generous ground contact and ease of handling.

Tread rollers have specially hardened rims to resist wear . . . have dirt seal rings and retainers.

Drums are extra wide, with large diameters . . . advantageous when operating as a dragline, crane or high-lift shovel, because of greater cable capacity.

Anti-friction bearings at all important bearing points, including the drums.

Extra-large air-operated clutches respond instantly to the slightest movement of the controls, reducing operator fatigue.

Torque converter increases output, reduces shock loading, prevents engine stall . . . cushioned effect of drive lengthens cable life, lowers machinery maintenance. Standard on Type 2400.

All gears, smaller parts and shafts that are subjected to extra wear are flame or induction hardened for longer life.

There is a Lima for every kind of mining operation. Shovels ½ to 8 cu. yds., cranes to 140 tons and draglines variable. Get full details on these powered-for-profit machines from your nearby Lima distributor, or write to Construction Equipment Division, Baldwin-Lima-Hamilton Corporation, Lima, Ohio.

Lima Type 604 1½-cu. yd. shovel and Lima Type 1201 3-cu. yd. shovel loading iron ore on Mesabi Iron Range.

DISTRIBUTORS IN PRINCIPAL CITIES OF THE WORLD

Cable Address LIMASHOVEL, Lima, Ohio, U.S.A.

LIMA Construction Equipment Division, Lima, Ohio

BALDWIN · LIMA · HAMILTON

6032

Shovels • Cranes • Draglines • Pullshovels • Roadpackers • Crushing, Screening and Washing Equipment

BALDWIN BLH LIMA-HAMILTON

OPENING A NEW ERA IN PERCUSSION DRILLING...

New PR123 GARDNER-DENVER Power Rotation Rock Drill

ABSOLUTE CONTROL

New Gardner-Denver PR123 gives your operator absolute and independent control of all these vital functions:

ROTATION WITHOUT IMPACT —efficient gear motor supplies rotation in either direction, even when drill is not impacting. Three rotational speeds.

IMPACT WITHOUT ROTATION —separate control provides drill impact without rotation. Percussion can be varied from light to heavy blows, and used to loosen couplings or stuck steel.

IMPACT AND ROTATION —use light percussion and rapid rotation for soft formations . . . or heavy impact and slow rotation for drilling hard rock.

UP TO 30% FASTER PENETRATION

New PR123 uses all hammer energy for percussion. There's no rotational drag on piston hammer. Results: faster hard-rock drilling than ever before. Depth of hole does not affect drilling speed.

SELECTIVE DRILLING

Now your driller can select the right combination of rotation speed, impact force, feed pressure and hole blowing for fastest penetration in any type of rock—can change drilling action as soon as the bit hits a new formation.

NO ROTATION PARTS IN CYLINDER

New PR123 has no rifle bar, ratchet ring, pawls, or other internal rotation parts that frequently cause trouble. Rotation is supplied by an efficient gear motor, and a torsion bar absorbs rotational shock between shank and motor.

POWER COUPLING AND UNCOUPLING

Independent power rotation is a time-saver. Rotation without impact permits power coupling of threaded rod without thread damage. Reverse rotation speeds uncoupling when coming out of the hole. Independent power rotation also helps free stuck steel.

Specifications: Piston diameter: 4½". Length: 38½". Weight, less mounting: 290 pounds.

GARDNER-DENVER Since 1859

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
International Division, 233 Broadway, New York 7, New York
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario

A NEW and DIFFERENT

The first machine ever designed for YOUR hauling problems

You can tell just by *looking* at an LW Haulpak® that it's quite unlike any other off-road hauler. Its bowl, for instance, has a distinctive "V" shape; its wheelbase is obviously shorter; it has clean lines, with none of the "hung on" tanks and cleaners so common to other haulers. Yet, these *noticeable* characteristics only *begin* to tell the story. The *fact* is that Haulpak is *completely* different from other off-road haulers!

Behind these differences are two facts: (1) Haulpak is built by a pioneer in heavy-duty *earthmoving* equipment; not by an automotive manufacturer . . . and (2) Haulpak is *designed*, from the ground up, *as an off-road hauler;* it is *not* just a beefed-up highway truck!

Haulpak differences are not "gimmicks", added on for the sake of being different. Everything you see in Haulpak has been carefully engineered with one objective in mind: to give you lower ton-mile costs on your off-road hauling.

Check the exclusive Haulpak advantages described in these pages. Then arrange with your LeTourneau-Westinghouse Distributor to personally inspect and test one of these high-production, low-cost machines. You'll see first-hand how LW Haulpak design can pay off for you.

How LW Haulpak pays off for **Utah Construction & Mining Co.**

Accurate records have been kept on an LW 32 Haulpak working for Utah Construction & Mining Co., Cedar City, Utah. When these records were last tabulated, the unit had been in use 10½ months. These are the performance figures:

JOB REPORT

Scheduled hours of operation		2,681
Hours Haulpak worked		2,211
Hours lost due to Haulpak downtime		250
Hours lost for other reasons than Haulpak being down		220
Operating efficiency $\frac{2,211 + 220}{2,681}$		90.7%
Best month's operating efficiency (except Aug. '58 which was 100%) was in November, 1958		98.0%
Hours of overburden haul	approx.	1,665
Total bank cubic yards overburden hauled		206,164
Total loads hauled		13,744
Bank yards overburden hauled per load	average	15
Average loads per hour (conditions: 2,000 ft. one way, grades from + 8% to − 8%)		8.25
Hours of iron ore haul	approx.	546
Total tons, ore hauled		80,266
Total loads of ore hauled		2,112
Tons of ore hauled per load	average	38.0
Average loads hauled per hour (conditions: 10,000 ft. one way, grades from + 5% to − 5%)	average	3.87

How does <u>your</u> availability and production compare?

Hauler...built for YOU!

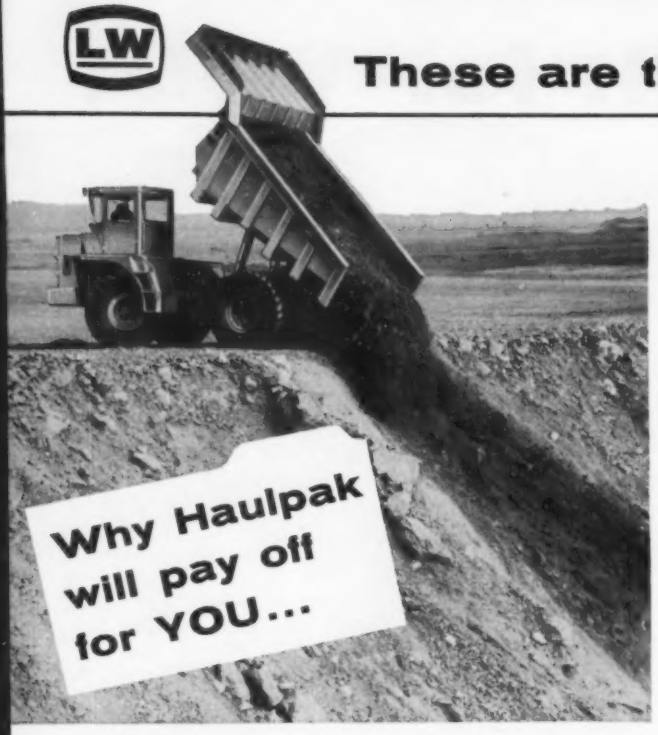
HAULPAK

LW 27.....27 tons

LW 32.....32 tons

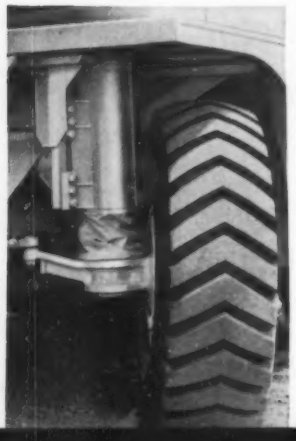
LW

These are the HAULPAK advantages



A highway truck cannot become an off-road hauler just by increasing its "iron", horsepower, or capacity. That's why LW engineers "threw out the book" when designing Haulpak. They started from the ground up to design a *new* concept in off-road haulers. The result is a bigger, tougher, faster, safer machine... with bigger returns on your hauler investment.

1. Biggest radiator in the business. Ample cooling even in 120° operation. (2,000 sq in. of frontal fin cooling, plus oil cooler for torque converter fluid.)
2. "Power-Miser" radiator fan, needs less than 10 hp to move 24,000 CFM of air. (Conventional fans need up to 35 hp!) Automatically disengages when not needed.
3. Cab, and engine hood, are fully mounted on rubber to isolate engine vibrations.
4. 15° windshield tilt reduces glare, keeps dirt and moisture from accumulating.
5. Automobile-sized steering wheel turns Haulpak full left to full right in only 4⅓ revolutions. In either direction, inside wheel can be cut full 45°, for non-stop turning circle only 45' in diameter!
6. 52"-wide cab for greater operator comfort and efficiency. Offset to left for full visibility. Five adjustable ventilators. "Buddy" seat for trainee or time-keeper.
7. Double-reduction rear-end of drive train, proved on LW earthmovers around the world. Only 6 big gears, not 12 little gears as in conventional drives. And over 50% stronger than conventional drive trains!
8. 15% less hp is needed to turn gear train than on conventional trucks. Double-reduction axle also permits bolt-circle wheel mounting, for far less trouble.
9. Final drive sections are interchangeable, right and left. All tires are same size and interchangeable.
10. Differential is famed LW power-transfer unit, unequalled for simplicity, trouble-free operation, and effectiveness.
11. Frame fabricated of special alloy, high-tensile-strength steel. Modified box section construction, continuous welded with integral front bumper, center members, and rear cross section ... for maximum strength.
12. Exhaust-heated body is standard. Keeps body dry for easy discharge of wet, sticky materials. Eliminates exhaust stack, and muffles operation of truck, for greater operator efficiency, safety.
13. Separate emergency power-steering system.
14. Power-assist steering is standard equipment. All steering components are at least 30" above ground.
15. 25" front ground clearance ... 6 to 10 inches more than other haulers.
16. 9'8" width between front wheels, compared to 7' on other trucks.
17. Aircraft-type multiple-disc brakes ... four times bigger than most haulers offer. *Three other brake systems,* including hydraulic retarder.
18. Body is completely rubber-mounted. No wear bars or end plates needed.
19. 4,750 cu in. of high-pressure air storage *in frame,* eliminates need for externally-mounted air storage tank.
20. Twin rams raise body 70° in 16 seconds! Inverted ram mounting avoids dirt falling into ram seals, permits shorter, simpler circuit.
21. Deep-well "V"-shape body carries about 6 tons of material below floor line of conventional vehicles. Gives Haulpak lowest center of gravity, solid stability on turns and side-slope operations.
22. Fuel (105 gallons) is stored in rear frame structure, with convenient center-fill. No need for big, clumsy tank, and not exposed to damage.
23. Straight, smooth body floor speeds ejection. No "kick up" at back, means unit stays steady, and on ground, when dumping.
24. Floor made of super-strength 100,000 PSI yield steel, as is *every* Haulpak surface in contact with the load!

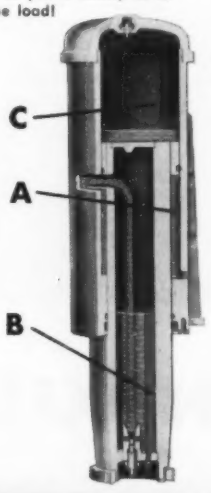


Perhaps the BIGGEST "difference": Revolutionary Hydrair* Suspension

Most unusual feature of Haulpak is Hydrair suspension. Each front wheel is mounted to a piston, which operates inside a frame-mounted cylinder. Surrounding the piston is a circular chamber of oil, (A) connected by tube to an oil reservoir (B) inside the piston. As the wheel rolls along surface irregularities, the up and down motion of the piston forces oil in and out of the piston reservoir. This, in turn, compresses and decompresses nitrogen gas contained in the space (C) above the oil reservoir, snubbing the overall movement of the piston and wheel, thus absorbing shocks and leveling the ride.

In addition to these "spring action" benefits, Hydrair eliminates the need for a front axle and related mountings ... providing substantially higher ground clearance ... and permitting an exceptionally short turn-radius.

*Trademark



that lower your costs . . . boost your output

See "Revolution on Wheels"...new color film on Haulpak...Ask your LW Distributor

As a specialist in earthmoving and off-road hauling, your LW Distributor can help solve your equipment problems. You'll find him and his staff interested in helping you in all phases of your business . . . from production problems, to machine selection, to financing. Put his experience and know-how to work for *you*. Ask for full details on LW Haulpak trucks. See his color film, "Revolution on Wheels".

HP-2255-G-4

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More proof that...

AMSCO HELPS YOU MOVE MORE TONS PER DOLLAR

How a large contractor and a crusher manufacturer have cut downtime and increased service life with AMSCO equipment

AT MT. VERNON CONTRACTING CORP.

DAILY "TOOTH REPAIR" ELIMINATED BY SWITCHING TO AMSCO 2-PART TEETH

Mount Vernon Contracting Corp. is a large general contractor doing work throughout the middle Atlantic states. Its present contract is for road construction on the Cross Westchester Expressway, linking the New York State and New England Thruways.

The firm's four power shovels and two backhoes on this job are equipped with Amsco dippers or dipper parts and Amsco Simplex* 2-Part Teeth. Reason: competitive teeth previously used required daily welding build-up to maintain their points. Now, since switching to the Amsco Simplex, teeth are changed only about once a week. And change-over is *only a 5-minute job!*

With shovels operating 8 hours a day, 5 days a week, this is a mighty important advantage for Mt. Vernon. No wonder they say—"These Simplex teeth really stand up in service, especially in rock, and save us a lot of downtime."

*Patent No. 2,904,908

AT HIGHWAY MACHINERY COMPANY

AMSCO CRUSHER ROLLS HANDLE 50,000 YDS. BETWEEN BUILD-UPS

Carroll Hicken (left) owner of Highway Machinery Company, Waukesha, Wisconsin, is a long-time user of Amsco equipment. His firm designs and manufactures self-propelled machines for crushing road material, both gravel and stone. All of their machines are rented out or sold to contractors, with maintenance and service handled by Highway Machinery.

For years, the company has used Amsco Manganese Steel Crusher Rolls exclusively. Amsco Manganese welding rods and bars are also used for build-up. On a typical rental machine, pictured at right, the Amsco rolls had *crushed over 50,000 yds. since their last build-up* six months before.

Mr. Hicken says that with Amsco Manganese rods he can multiply the life of a roll by 5 to 10 times. He adds—"They have proven very fine, and we're getting more yardage than with any rods we formerly used."

AMSCO

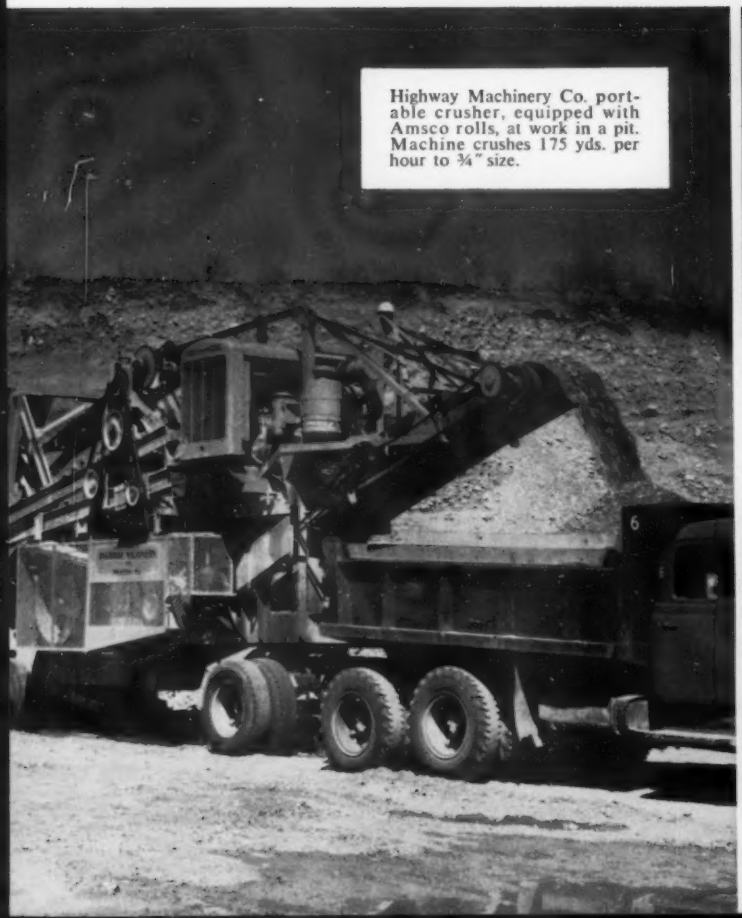
AMERICAN Brake Shoe COMPANY

American Manganese Steel Division • Chicago Heights, Ill.

Other plants in: Denver • Los Angeles • New Castle, Dela. • Oakland, California • St. Louis
In Canada: Joliette Steel and Manitoba Steel Foundry Divisions
Welding products distributed by Canadian Liquid Air Co., Ltd.

Northwest shovel, equipped with Amsco Dipper and Simplex 2-Part Teeth, at work on Cross Westchester Expressway project.

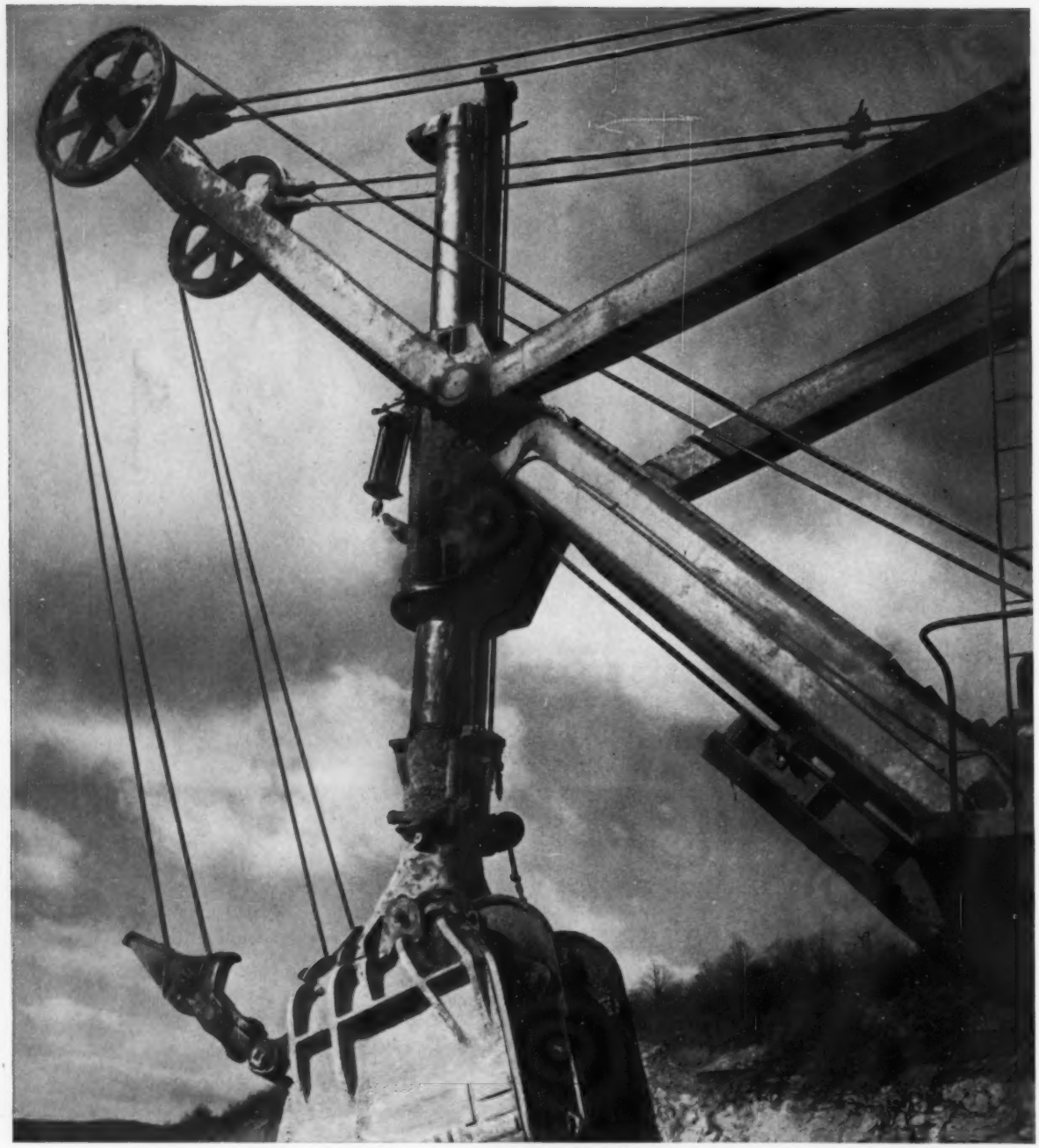
Shovel operator, Walter Reich, inspecting Amsco Simplex 2-Part Teeth used on Mt. Vernon Contracting Corp. shovel.



Highway Machinery Co. portable crusher, equipped with Amsco rolls, at work in a pit. Machine crushes 175 yds. per hour to ¾" size.

Amsco 25 x 24 manganese steel crusher rolls, of type used in portable crusher at left.

Welder demonstrating how Amsco Manganese rods are used for build-up on rolls.



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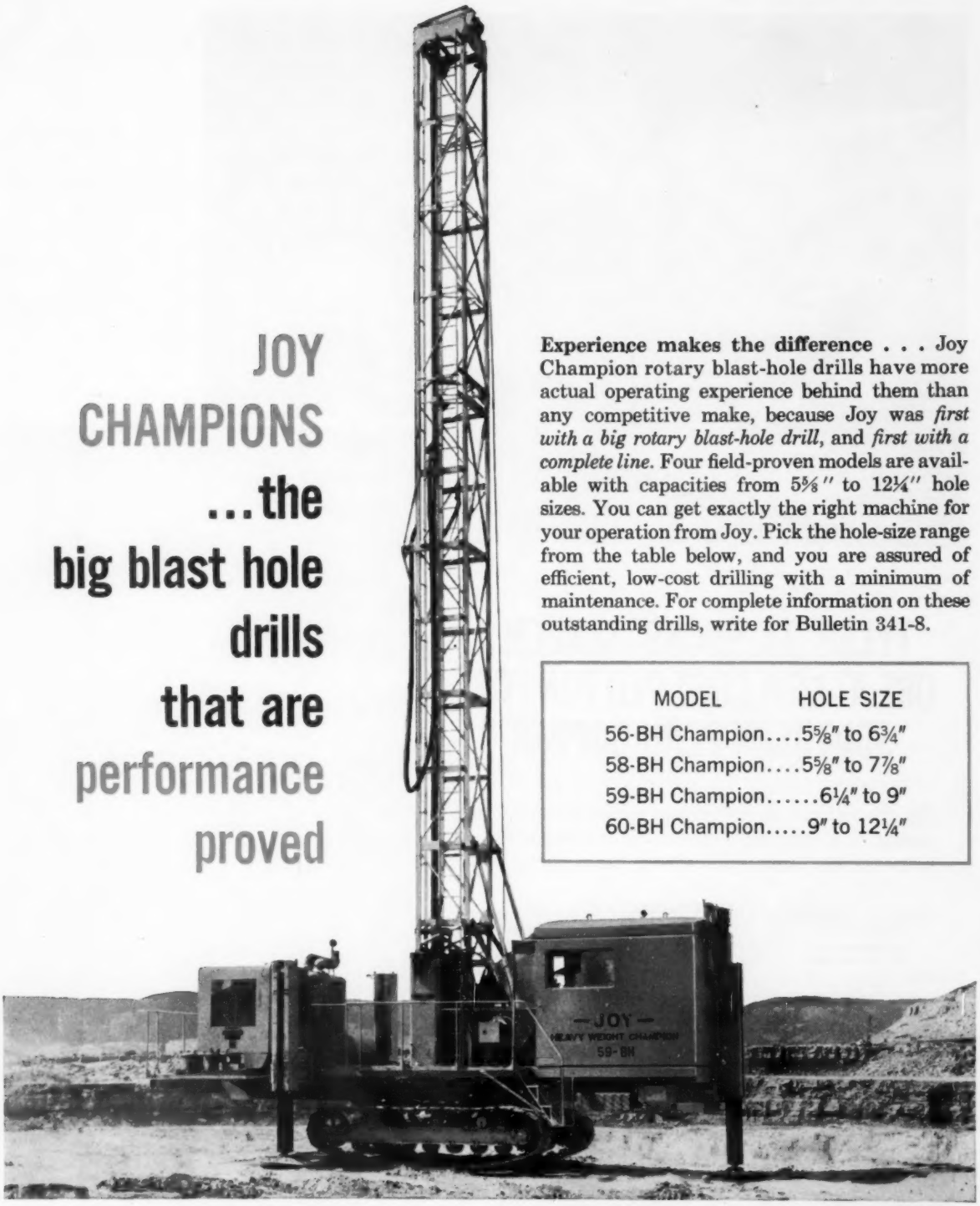
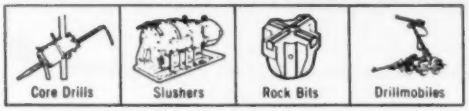
JOY CHAMPIONS ...the big blast hole drills that are performance proved

Experience makes the difference . . . Joy Champion rotary blast-hole drills have more actual operating experience behind them than any competitive make, because Joy was *first with a big rotary blast-hole drill*, and *first with a complete line*. Four field-proven models are available with capacities from 5⅝" to 12¼" hole sizes. You can get exactly the right machine for your operation from Joy. Pick the hole-size range from the table below, and you are assured of efficient, low-cost drilling with a minimum of maintenance. For complete information on these outstanding drills, write for Bulletin 341-8.

MODEL	HOLE SIZE
56-BH Champion	5⅝" to 6¾"
58-BH Champion	5⅝" to 7⅞"
59-BH Champion	6¼" to 9"
60-BH Champion	9" to 12¼"



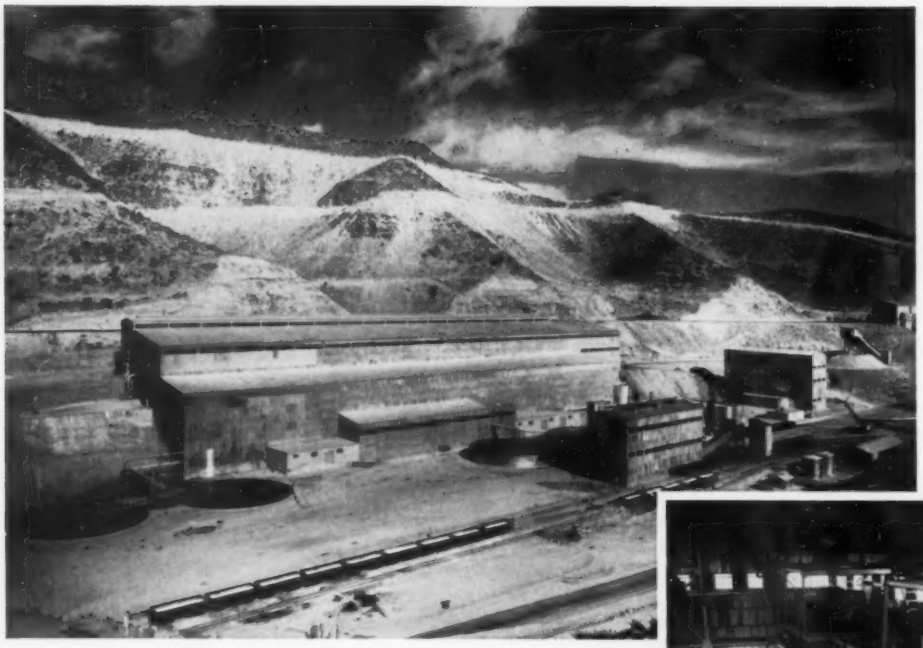
EQUIPMENT FOR MINING... FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario



At new Toquepala mine of Southern Peru Copper Corporation, four Ty-Rock Screens are used at Crushing Plant, one Ty-Rock at the Sample Mill. Ty-Rocks were chosen because of their proven ability to handle large tonnages of ore at exceptionally low cost per ton. Ty-Rock fully controlled vibration assures long life.

TYLER "TY-ROCKS" SCREEN ORE AT LOW COST PER TON FOR SOUTHERN PERU COPPER

For the ultimate in heavy-duty screen performance choose Ty-Rocks. Full information in Catalog 68 — write for free copy.

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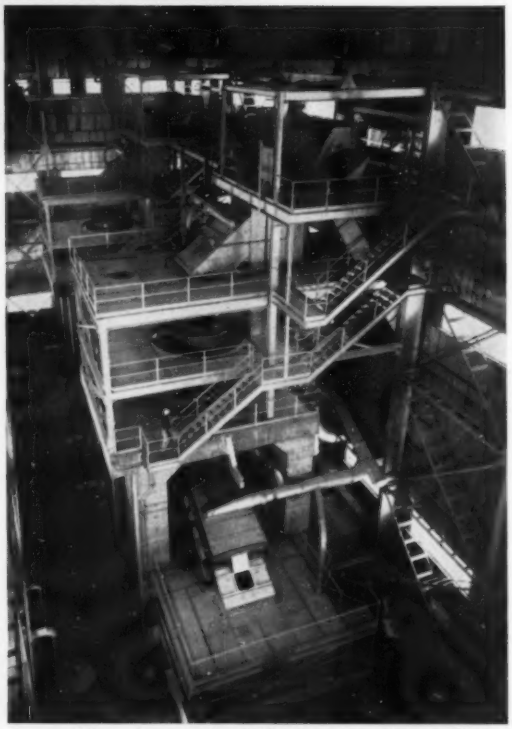
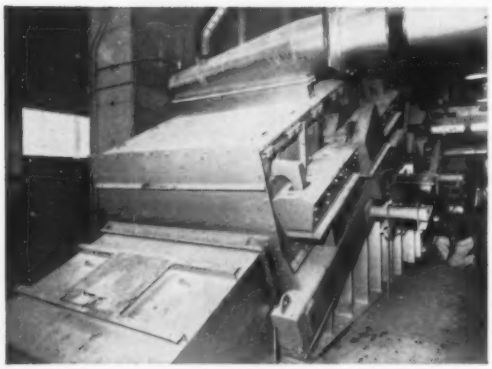
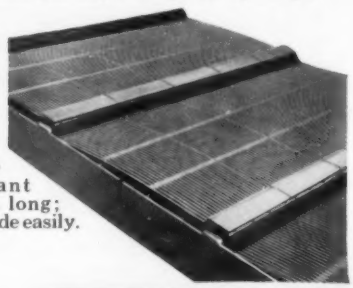


In crushing plant each of the four 6' x 12' Ty-Rocks screen 550 tons per hour of minus 2" porphyry copper ore, 3 to 5% moisture, with approximately 160 tons per hour passing through ⅝" openings.





Special decks used on these screens are made of abrasion resistant alloys. Service life is long; replacement can be made easily.

WOVEN WIRE SCREENS • SCREENING MACHINERY • TESTING SIEVE EQUIPMENT

TYLER

Who Will Build Uranium Mill in Shirley Basin, Wyoming?

Wyoming's Shirley Basin district may well be the site of the last uranium mill to be built in the United States under current AEC programs through 1966.

Deep drilling indicated sufficient ore reserves in the basin for a mill prior to the November 24, 1958 guaranteed market termination by the AEC. However, total allocation is split between several companies so that no single company has a large enough AEC yellow cake allotment to warrant building a large capacity low treatment cost mill. This means that the company which controls the majority of allotments can control milling. And the company that both mines and mills earns a far greater profit than does the straight mining company.

The three largest, and equal allotments, are reported held by Tidewater Oil Company, Utah Construction and Mining Company, and Kerr McGee Oil Company (Kermac Nuclear). Gas Hills Uranium Company, Sasso and Simmons, Shirley Basin Development Company, and others have smaller allotments. When Utah secured quit claim option on Sasso and Simmons 400 Foo claims they also, and most importantly, secured market allocation for 1,000,000 pounds of yellow cake to make them largest allotee in district.

Both Tidewater and Kerr-McGee have considered mills, but Wyoming observers report that Utah has a time and operating advantage in that it has already started underground mining and sunk its Christensen shaft to a depth of 400 feet as main production shaft for deeper ore horizons. Deep ore on Foo claims which immediately adjoin Utah on northwest can be easily mined.

Underground work in the district makes it look like a second Ambrosia Lake. There's lots of water and drill logs show many fine grained sand and silt horizons in, above, and below the ore horizons. In addition to pumping through the Christensen shaft, Utah is pumping through a series of surrounding churn drill holes to lower water table in mine area.

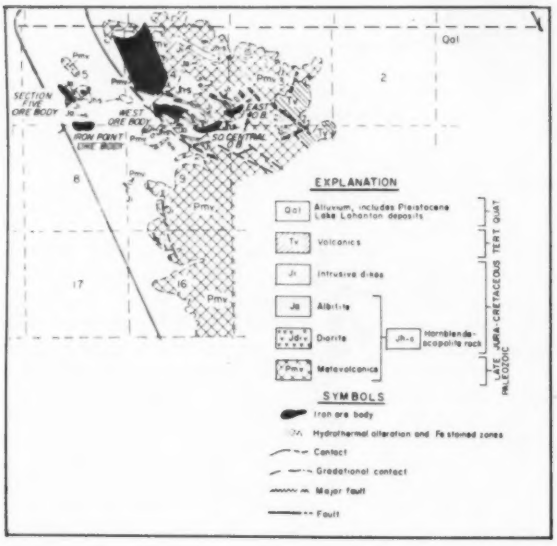
Newmont To Manage Eureka, Nevada Lead-Zinc Drilling

Newmont Mining Corporation will manage a new deep exploration drilling program in the Fad shaft area of the Eureka, Nevada lead-zinc-silver property of Eureka Corporation of Toronto. Both Newmont and Cyprus Mines Corporation will invest $250,000 in the project, as will Eureka and Richmond-Eureka Mining Company, owner of the property.

With the two American firms participating and recent settlement of a lease dispute with Richmond-Eureka, the Canadian firm will get another chance to further develop and mine the ore body where it has invested millions of dollars since the 1930's. A major water problem has always prevented deep mining.

Newmont will drill a series of deep holes to further prospect the ore deposit in the Fad shaft area in the hope that a large enough tonnage will be indicated to justify the cost of solving the water problem. Earlier several deep drill holes indicated a high grade base metal deposit.

U.S.Steel Moves To Control Large Nevada Iron Ore Reserves



Columbia Iron Mining Company, the western mining subsidiary of United States Steel Corporation, has signed an option and purchase agreement with Mineral Materials Company for its Nevada iron ore claim, open pit mines, and dry magnetic beneficiating plant. These properties are in the Buena Vista Hills district, Churchill County. If the option is paid within the first year, price will be $4,500,000.

The arrow on the map points to Mineral Materials' West ore body, the largest in the district, which is 2,000 feet long, at least 450 feet wide, and has been drilled to 500-foot depth. Columbia Iron has moved a geological crew to the mine, contracted a diamond drilling program to Boyles Brothers Drilling Company of Salt Lake City, Utah, and is sending cores to Colorado School of Mines Research Foundation for metallurgical testing.

Since 1952 Mineral Materials has mined and milled 1,200,000 tons of ore from a small open pit. Reserves indicated by earlier drilling are estimated at about 50,000,000 tons of 30 percent grade.

Acquisition of Nevada iron ore reserves is another step toward a Pittsburg, California blast furnace. Coking coal could come from recently optioned mines at Crows Nest Pass, British Columbia.

MAJOR MINES COVERED IN THIS ISSUE

South American Mining

Free World's Bulwark of Mineral Resources Destined for Even Greater Growth in Future

Mine project activity in South America has hit an all-time high, and it is apparent that the mining industry on the continent has entered a period of unparalled growth. For this issue, the editors of MINING WORLD contacted every major South American producer to develop information.

On the pages that follow are the plans, the methods, and the outlook for expansion at 22 of South America's leading mining and metallurgical installations.

Expansion of productive mine capacity in South America is only logical. Reserves are abundant and labor is cheap. This expansion will become absolutely inevitable if the political and investment climate remains attractive.

Most of the future mine expansion will take place in fairly well defined areas of iron ore, copper and bauxite. New developments, however, are slated in nickel, manganese, and of course, in lead-zinc output where South America has always been a leading producer.

IRON ORE is scheduled for a 68 percent growth in productive capacity by 1965. If greater demand develops the output could even be doubled. Most South American iron ore can be mined from any of the developed mines, or potential sources slated for immediate development, and placed aboard ocean-going carriers for $4.50 per ton. The above figure succinctly sums up the economic attractiveness of South American iron ore. The grade of this ore is exceptionally high by United States Iron Range standards and most of this ore also has excellent physical and chemical specifications. This explains why South American iron ore is sought by steel makers throughout the world and why the ore finds a ready acceptance in world markets. Iron ore producers on both the east and west coasts of South America are equipped to compete for world markets with the above factor working to their advantage.

Among notable iron ore events discussed in this issue is the start of construction of Marcona Mining Company's $22,000,000 iron ore beneficiation plant in Peru. It will be ready by late 1961. Acari, operated by Pan American Commodities, and a close neighbor of Marcona, will eventually expand its beneficiation plant which now depends on magnetic cobbing alone. Acari is South America's newest iron ore producer and will develop the first underground iron ore mine in South America.

Vale do Rio Doce in Brazil is well advanced in plans for future beneficiation of huge amounts of iron ore fines accumulated during daily production operations. This company will probably also design facilities for upgrading some sub-grade ore which does not meet the spectacular 63 to 64 percent iron content that Rio Doce now regularly ships.

In Chile, Minera Santa Fe has plans for development of a huge iron ore deposit known as El Laco for an eventual output of 10,000,000 tons of ore per year. Santa Fe is also building an 11-kilometer conveyor for the Carmen mine, and this will be one of the longest belt systems in the world. It was based on economic and engineering studies by Soros Associates, will carry 1,500,000 tons of ore downhill per year.

Two additional major iron ore projects could unfold in South America in the near future. One would be by Hanna Mining Company in Brazil, and the other by a well known United States mining company.

IN COPPER the Toquepala project of Southern Peru Copper Corporation and the El Salvador Project of Andes Copper Mining Company were the primary developments. Both are now in production. Combined, these two projects required an expenditure of over a third of a billion dollars and they will contribute an estimate 240,000 tons of copper yearly to free world supplies.

Other important events are shaping up for copper. Cerro de Pasco Corporation's preliminary development plans for the Rio Blanco property in Chile are discussed in this issue. This project is being geared for an 11,000 ton-per-day block caving operation with an underground mill. Empressa Minera de Mantos Blancos, S. A., is developing a 3,000 ton-per-day mine and plant to treat a copper chloride deposit in Chile. This latter project, discussed in this issue, will involve a completely new and unique hyrometallurgical process to recover cuprous chloride which will then be smelted to make a fire refined copper.

Two new smelter projects are underway or slated for Chile and a third new smelter is a definite possibility. Empressa Nacional de Fundiciones has broken ground for a new copper smelter at Las Ventanas, near the port of Quintero, Chile. It will require an outlay of about $9,000,000 and is expected to be operational by the middle of 1962. Andes Copper Mining Company has been working on engineering design for a smelting and refining plant to be built at the port of Chanaral, Chile. This plant would receive concentrate from Andes Copper's new El Salvador project. Under consideration for this project is the delivery of the copper concentrate to the smelter via an approximate 60-mile gravity pipeline.

IN BAUXITE, earthmoving methods of the producers represent an interesting study. Producers are forced to handle increasing amounts of overburden and each of the four major company's has developed a different method. Suriname Aluminum Company is stripping waste with a dredge. . . . N. V. Billiton has just put a bucket wheel excavator into operation. . . . Demerara Bauxite Company, Ltd., is still using the time honored method of washing away soft layers with hydraulic monitors and digging the hard layers with draglines. . . . Reynolds Metals Company is using Euclid loaders, a machine with self contained cutting edge and conveyor belt, for its stripping problem.

IN LEAD-ZINC Cia. de Minerales de Santander Inc., owned ⅔ by St. Joseph Lead Company, went into production in January 1959. Daily production is 500 tons of ore from an open pit in Peru, about 15,000 feet above sea level.

Cerro de Pasco Corporation, South America's largest lead-zinc producer, also has long range plans for developing an open pit. Cerro is also undertaking modest expansion of lead and zinc smelting and refining facilities in Peru.

IN MANGANESE, a new mine will be in production in British Guiana by mid-1960. Opinion has been expressed that the structure on which this mine is developed will also reveal additional important manganese deposits.

END

Iron Ore Industry is Young, Vigorous and

Direct Shipping Reserves	20,000,000,000 tons
Aggregate Estimated Reserve	60,000,000,000 tons
Present Annual Production Capacity	32,000,000 tons
Potential Production by 1965	55,000,000 tons

Brazil Has Largest South American Reserves

The proven iron ore reserves of South America are so large that huge potential medium grade deposits will not be touched for a long time. Domestic consumption is relatively small, but will grow with the relatively rapid industrial development now under way. Even so, the export business is good now and will probably get a lot better.

Only a small part of the total area of South America favorable for iron ore deposits has been reliably evaluated. Geologic mapping and exploration of known deposits have established the direct shipping and aggregate reserves shown above. They amount to approximately one-fifth of the world total.

Among countries of the world, Brazil's iron ore reserves may well rival those of India. Brazilian resources that may have important commercial potential have been found in (1) State of Mato Grosso, about 16° south and near the Bolivian border; (2) State of Bahia, near its southern border about 350 miles inland; (3) State of Ceara in northeastern Brazil; (4) and in the Territory of Amapa close to the mouth of the Amazon River.

The iron resources of greatest current commercial interest, however, are in an area of about 7,000 square kilometers, known as the Quadrilátero Ferrífero in the south central part of the State of Minas Gerais and in small deposits in the state of São Paulo, near the city of São Paulo.

The Quadrilátero Ferrifero is characterized by metamorphosed sedimentary beds of banded specular hematite-quartz similar to the specularite jaspilite deposits of our Lake Superior district. This rock, known locally as itabirite, is the origin of the three types of iron-ore deposits. They are: (1) surficial deposits of itabirite from which most of the silica has been leached leaving soft to medium hard ore containing 50 to 59 percent iron; (2) blocks or masses of hard, high-grade ores, of almost pure hematite containing up to 69 percent iron, that occur within the softer itabirite; and (3) deposits of lateritic ore or soft itabirite containing less than 50 percent iron. The soft itabirite and laterite can be easily concentrated with Humphrey spirals or gravity equipment.

Minas Gerais iron deposits contain an estimated 16,000,000,000 tons of hematite ore containing 50 to 60 percent iron, and an estimated 35,000,000,000 tons of itabirite potential-ore containing more than 30 percent iron.

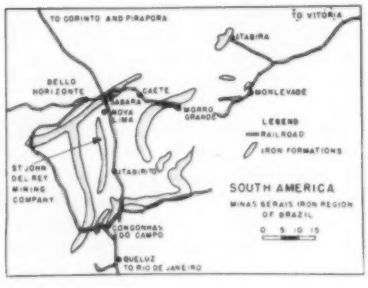
MAP SHOWING MINAS GERAIS IRON REGION OF BRAZIL, S. AMERICA

Reserves of high-grade lump hematite ore, 66 to 68 percent iron, exceed 1,000,000,000 tons. This high-grade ore is excellent open-hearth feed and until 1958 was the only Brazilian ore mined for export.

Commercial iron deposits in the State of São Paulo are massive magnetite. They are important to the local steel industry but contain only 3,000,000 or 4,000,000 tons of ore. The average grade is about 60 percent iron.

Brazil produced 5,200,000 tons of high-grade ore for domestic and export iron-ore markets in 1958. All but a few thousand tons of this was produced by mines in the Quadrilátero Ferrífero of Minas Gerais.

The Quadrilátero Ferrífero iron-ore formation is almost continuous but has been developed by mining only where



Growing Fast

By Sumner Anderson

and Horace T. Reno

Mr. Anderson is Latin American specialist and Mr. Reno is assistant chief, Branch of Ferrous Metals and Ferroalloys, United States Bureau of Mines. This paper was delivered before the 21st annual mining symposium sponsored by the University of Minnesota. Complete symposium proceedings are available from the university.

railroad transportation has been provided. Many small mines that produce for local consumption are near the railroads south and east of Belo Horizonte, Minas Gerais, and there is a group of mines at Monlevade about 50 miles east. Congonhas and Itibira are the only recognized mining districts.

The Congonhas district is about 40 miles south of Belo Horizonte. It is served by the broad gauge Estrada de Ferro Central do Brazil that connects with Rio de Janeiro 300 miles by rail to the southeast and by two narrow gauge stub-laterals east and west. The Casa de Pedra open-pit mine is the largest mine in the district. It is operated by Companhia Siderurgica Nacional (National Steel Co.), one of the largest mining companies in Brazil. Casa de Pedra produces about 1,000 tons of high-grade ore a day on one shift and could easily double or triple its output. Screening is the only beneficiation necessary. The lump ore is shipped to the Volta Redonda steel mill, and the fines are wasted.

Itabira is located about 50 miles northeast of Belo Horizonte. Companhia Vale do Rio Doce operates modern mechanized mines in this district. (See report which follows this section.) Companhia Siderurgica Belgo Mineira is the third largest producer of iron ore in Brazil. It operates charcoal iron and steel furnaces at Sabara and Monlevade and produces iron ore for its own account from nearby mines.

Brazil has embarked on a program of industrialization that will probably more than double its iron-ore requirements within the next decade. Domestic requirements for iron ore, however, can be met without affecting Brazil's ability to produce iron ore for export.

Brazil sells high-grade lump ore in the United States, England, West Germany, and Japan, and is establishing a market for soft ore in Poland and Czechoslovakia. Foreign demand for Brazilian open-hearth ore has in general kept pace with export capacity and will probably continue to do so until new transportation facilities are built from Minas Gerais to the coast. The grade of the soft ore will assure its acceptance by Western European and Soviet bloc countries that are in need of high-grade ore to raise their metal production capacity. Brazil apparently will be able to market 10,000,000 to 15,000,000 tons of high-grade iron ore per year in foreign countries by 1965.

Status of Brazil's iron-ore industry: Accessible high-grade reserves greatly exceed any demand foreseeable in the next 2 or 3 decades. Low-grade resources are enormous. Most operating mines have large stocks of high-grade fines. Current production is at the rate of about 5,000,000 tons of high-grade ore per year, 3,500,000 tons of which is exported. Within the next decade iron ore will be produced as needed for domestic consumption—probably not more than 3,000,000 or 4,000,000 tons a year. Both blast furnace and open-hearth ore will be exported, and exports will increase to 7,000,000 or 8,000,000 tons per year within the next five years and may reach 10,000,000 to 15,000,000 tons if adequate new transportation facilities are built.

Venezuela Ranks Second in Iron Ore Reserves

All the known Venezuelan deposits of any significance are south of the Orinoco River in the State of Bolívar and the Territory of Delta Amacuro. The ores are similar to itabirite and the hematite ores of our Lake Superior district and were formed similarly by enrichment through leaching of ferruginous metamorphosed Precambrian sedimentary strata. The Venezuelan government and private companies have developed proven reserves of about 1,000,000,000 tons of high-grade direct-shipping ore and probable reserves of 3,000,000,000 tons.

The iron ore industry of Venezuela is new. It started in August of 1950 when Iron Mines Company of Venezuela, a subsidiary of Bethlehem Steel Company, began mining at its El Pao

concession. El Pao is about 40 miles south of the confluence of the Orinoco and Caroni Rivers. Iron Mines of Venezuela has an estimated reserve of 85,000,000 tons at El Pao. (See description of mine on following pages.)

Shortly after El Pao was put into production United States Steel Company organized Orinoco Mining Company to develop and mine the Cerro Bolívar deposit, 60 miles southeast of Bethlehem's El Pao operation. (Orinoco Mining is described in a following report.)

The Western Ore Company, Maria Luisa Ore Company, Trans-Western Ore Company, and three Venezuelan nationals hold valid iron ore concessions in the iron ore district south of the Orinoco River. The Venezuelan Government, however, has closed the area to further mining claims and put most of the remaining iron ore deposits in the Federal Reserve.

At present, El Pao and Cerro Bolívar are the only active iron ore producers in Venezuela. Combined out-

Chile Has an Iron Rush and Iron Ore Will Soon Replace Nitrates as the Country's

Approximately 200,000,000 tons of high-grade ore have been proved in a mineralized area near the coast, in the provinces of Atacama and Coquimbo, Chile. Another 500,000,000 tons of potential ore have been indicated in beach sands south of Valparaiso and at Relun in the Nahuelbuta Range between Lake Llau-Llau and the river Relun, in the Province of Arauco. In addition, El Laco iron-ore deposits, 250 miles inland from the port of Antofagasta and about 15,000 feet above sea level in the Province of Antofagasta, were discovered in 1958. El Laco contains an estimated 100,000,000 to 1,000,000,000 tons of ore.

The proven reserves of Atacama and Coquimbo are in hematite-magnetite deposits formed by magmatic segregation within a batholith of granodiorite, or in hematite-magnetite deposits formed at the contact of the batholith and surrounding rock. The beach sands south of Valparaiso contain about 25 percent iron and 0.2 percent titania in magnetite. Potential ore deposits at Relun contain about 40 percent iron as fine hematite in sedimentary siliceous beds similar to the Lake Superior hard jaspilites. The newly discovered deposits at El Laco, Antofagasta Province are magnetite.

Since 1954 Chile has experienced what is best described as an "iron rush." It has been led by the Chilean companies, Santa Fe and Santa Barbara. Compãnia Minera Santa Fe began operations in 1951 and began buying ore for export from small producers in 1954. Compãnia Minera Santa Barbara started producing ore for its own account in 1954 and began buying ore from small producers in 1955. Bethlehem Chile Iron Company opened the El Romeral mine late in 1955 in a joint venture with Compãnia de Acerco del Pacifico to provide ore for the Huachipato steel plant. El Romeral also replaced part of the output lost by the closing of El Tofo mine which Bethlehem Chile operated from 1913 to 1957, producing 48,000,000 tons of high-grade ore.

Compãnia Minera Santa Fe is the largest iron-ore producer in Chile. Santa Fe operates several open-pit mines in the Atacama and Coquimbo district, producing about 1,500,000 tons a year from its own mines, and also buys about 500,000 tons a year for export from numerous small operators in the vicinity.

The Bethlehem Chile Iron Co. with the El Romeral mine is the second largest iron-ore producer in Chile. The ore is mined in an open-pit and transported on a one-meter gauge railroad to the port of Guayacan in Coquimbo Bay, 24 miles south. The mine and facilities have a capacity of about 1,000,000 tons a year.

Compãnia Minera Santa Barbara is the third largest of the iron-ore producers in Chile. It operates the open-pit Huanteme mine near Vallenor, which produces about 500,000 tons of ore a year. Santa Barbara also buys ore for export from small independent producers to bring its total of iron ore available for export to about 750,000 tons a year. Santa Barbara ore is trucked about 10 miles from the mine to the State railways, and from there it is transported 22 miles by rail to the port of Huasco.

Societe Minera Cerro Iman operates the Cerro Iman iron ore deposit about six miles west of Copiapo. Mine production and ore purchases from independent miners total about 300,000 tons a year. Cerro Iman sells about 40 percent of its production to Santa Fe and the balance for export is handled principally by Associated Metals and Minerals Corporation. The ore is shipped through the port of Caldera, where loading facilities and warehouse storage capacity of 130,000 tons are available.

In 1958, Chile produced 3,700,000 long tons of iron ore. Although the nation is a long distance from the world's iron ore markets, the high-grade ore and low cost production are

Peru Has Been Only Partially Prospected for Iron Ore, New Projects Will Soon

Peru's known iron-ore resources total about 800,000,000 tons, and another 200,000,000 tons or more have been indicated in known areas of iron mineralization. The country has been only partly prospected for iron ore, and inasmuch as some of the "iron boom" has extended into Peru we can expect that knowledge of its iron-ore resources will be substantially increased within the next few years.

The principal iron-ore resources are at Marcona, 250 miles south of Lima. These deposits are metasomatic replacements in metamorphosed sedimentary strata close to the contact of a granitic batholith. Limonite and hematite are the principal minerals, although magnetite has been found at depth. About 200,000,000 tons of high-grade ore has been measured or indicated in the Marcona area, and 450,000,000 tons of medium grade ore has been inferred. Huacravilca, a lime-granite contact zone deposit, in the Department of Junin Province of Huancayo, and Tambo Grande, a replacement deposit in limestone near a granitic mass in the Department of Piura, together, contain approximately 100,000,000 tons of hematite ore. The Compãnia Explotadora de Hierro de Acari reportedly has proven 5,000,000 tons of high-grade ore and indicated a large tonnage of potential ore in 12 magnetite shear zones in grano-diroite near Marcona. The four known deposits in Peru contain a total estimated iron ore reserve of 800,000,000 tons.

Until late in 1959, The Marcona Company was Peru's only significant producer of iron ore. Marcona ore is mined from open pits and transported about 17 miles to the Port of San Juan in 60- and 80-ton truck trailers. Present mine capacity is approximately 4,000,000 tons per year.

Panamerican Commodities, S. A., a Peruvian Company financed partly by the American Overseas Corporation, is developing the Acari deposits in the Andean foothills. The first shipment from Acari was made in August 1959. The mine is located 600 kilometers

put in 1958 was a little over 15,000,000 tons. United States consumers have first priority on the entire output of the El Pao and Cerro Bolívar mines. When not all the ore is needed in the United States, some is marketed in Great Britain, West Germany or Italy. Small shipments have occasionally been sent to Japan and Belgium.

There is no publicly announced firm plan to develop other iron ore deposits in Venezuela. The output capacity of El Pao is compatible with its reserve. Cerro Bolívar probably is producing close to its capacity.

The status of the Venezuelan iron-ore industry: Reserves exceed 4,000,000,000 tons, current production capacity is about 18,000,000 tons a year, and it does not seem likely that it will be increased substantially in the near future. Part of Venezuela's iron-ore output can be sold in European markets, but all of it will be sent to the United States if it is needed here.

Second Most Important Mineral Product

factors that make Chile's output competitive. No reduction in trade with the United States is anticipated. With independent producers actively trying to sell ore to independent steel companies, production may reach 5,000,000 tons a year shortly.

Most of Chile's foreign trade with the exception of the United States has been with West Germany. There is, however, no apparent reason why Chilean high-grade ore can't be sold in the United Kingdom and the Soviet bloc countries.

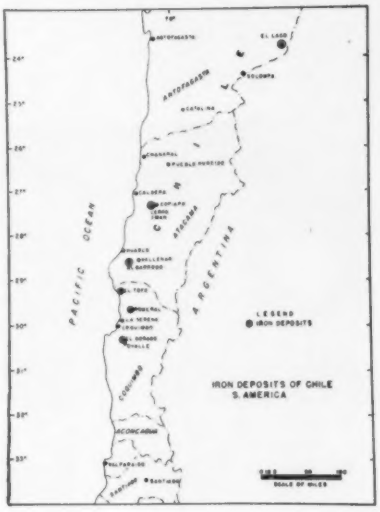
Companies in the Atacama and Coquimbo provinces should be able to increase iron ore output for export to at least 5,000,000 tons a year as fast as markets develop. The capacity of present facilities is more than this.

High-grade reserves of the El Romeral mine have been estimated at 18,000,000 tons. Santa Fe's reserves, excluding El Laco, are at an absolute minimum of 50,000,000 tons and believed to be between 50,000,000 and 100,000,000 tons. Each of the properties operated by Santa Barbara and Cerro Iman has developed reserves of 1,000,000 to 5,000,000 tons; several of the latter are reported to have probable reserves of 10,000,000 tons or more.

The Algarrabo deposit, 50 kilometers southwest of Valinar in the province of Atacama and about 1,000 feet above sea level, is the most valuable property in the Atacama-Coquimbo area. It contains 50,000,000 to 70,000,000 tons of high-grade ore. Compãnia Acero del Pacifico has acquired control of the deposit from William Mueller & Company of the Netherlands and American Overseas Finance Company. It is expected that the mine will be ready for production in 1961 at an annual rate of 1,000,000 tons of open hearth ore and 500,000 tons of fine ore for blast furnace use. The Huachipato steel plant will have first call on this ore.

Santa Fe has announced that it will develop the El Laco deposit to produce 7,000,000 to 10,000,000 tons of 60 percent iron ore a year. Analyses of El Laco ore show an iron content of over 64 percent with a phosphorus content ranging from 0.06 to 0.70 percent. Apparently appreciable amounts of apatite are in the ore. Reserves in the El Laco field have been estimated at over 1,000,000,000 tons. Considerable interest in this property has been evinced by American producers, which indicates that the ore is of a phosphorus content which can be readily used in the U. S.

Status of Chile's iron-ore industry: 200,000,000 tons of high-grade ore is immediately available to support the



companies producing for the export market. Current capacity to produce ore for export is 6,000,000 to 7,000,000 tons a year. Mines being developed will bring this capacity to about 9,000,000 tons a year by 1961. Domestic consumption is about 500,000 tons a year and probably will double by 1965. Chile is now exporting about 4,000,000 tons of iron ore a year and probably will increase its exports to Japan and European countries. This will bring total iron ore trade to at least 5,000,000 tons a year by 1952.

Double Nation's Output

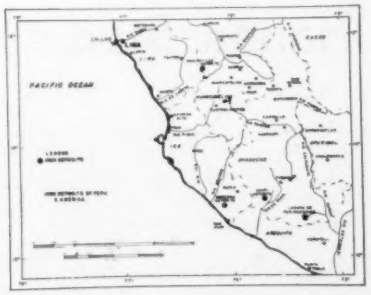
south of Lima and about 50 kilometers east of the Marcona deposits. Panamerican has completed a 37-mile highway from the mine to the port of San Juan where it has constructed a dock and ship loading facilities.

Acari production will be at the rate of about 1,000,000 tons per year, and the company plans to increase this to 3,000,000 tons as markets develop. The combined annual capacities of Marcona and Panamerican will reach 6,000,000 tons within five years.

Current status of the iron-ore industry of Peru: A readily available reserve of 400,000,000 to 500,000,000 tons is adequate to support present production capacity of about 3,000,000 tons per year and an expected capacity of 6,000,000 tons per year. Consumption of iron ore is less than 100,000 tons per year and is not expected to exceed 200,000 tons per year within the next decade.

Brazil, Venezuela, Chile, and Peru are the only countries in continental South America that are currently or will in the foreseeable future produce iron ore for export; however, Argentina, Colombia, and Bolivia have iron resources significant to their economy.

The known iron-ore resources of Argentina total about 180,000,000 tons of 40 to 50 percent ore in deposits of sedimentary origin, high in silica. The largest deposit at Sierra



Grande will be particularly important to the steel industry that the Argentine Government is now developing, but location and grade preclude its being exploited to produce iron ore for export. END

Rio Doce to Double Production, Plans Now for

An immediate program designed to double iron ore production from 3,000,000 to 6,000,000 tons per year has been undertaken by Companhia Vale do Rio Doce, Brazil's largest iron ore producer and exporter. This project involves an increase in output of lump and mine-run ore over ½-inch in size.

CAUE MINE in background is largest of three Rio Doce mines and features conveyor belt delivery of ore to plant.

Dried Ore Has This Analysis

Product	Percent
Iron	68.8
Phosphorous	0.025
Silica	0.35
Manganese	0.04
Alumina	0.02
Sulphur	0.012
Moisture	0.6

Coupled with this expansion are plans for installation of beneficiation facilities for treatment of itabirite fines, minus ½-inch in size. This will provide the company with still further expansion of the 6,000,000-ton goal in the future. It will also provide Vale do Rio Doce with complete flexibility for competing in world iron ore markets. The company will be able to meet the demand for all types of high-grade iron ore, including agglomerated fines tailored for blast furnace feed.

It is expected that the first round of expansion to the 6,000,000-ton-yearly goal will be attained by 1961. The Export-Import Bank of Washington has loaned Vale do Rio Doce $12,500,000 for this project. The funds will be used to purchase railroad, port and mining equipment in the United States. The expansion will add significantly to Brazil's foreign exchange, and will favorably enhance the country's balance of payments in the future.

Companhia Vale do Rio Doce was organized in 1942 to mine, transport and export 1,500,000 tons of iron ore per year. This capacity has already been doubled. In 1959 exports reached 3,210,092 gross tons of high-grade ore mined from the three deposits controlled by the company. Of the total shipments, 978,997 tons were directed to the United States. The three deposits now mined are located in the vicinity of Itabira, State of Minas Gerais. The Brazilian government owns 86 percent of the company's stock. The main office is located in Rio de Janeiro.

The ore is transported from Itabira to the port at Vitoria over the modern Vitoria-Minas railroad, owned by the company. In addition, the company operates the ore loading facilities at Vitoria, State of Espirito Santo. The port is being dredged so that larger ore carriers of 25,000 to 35,000-ton capacity can be loaded. Changes are also being made to the Vitoria ship loading installations to increase to 2,000 tons per hour the rate at which vessels can be trimmed.

The rich Itabira iron ore (hematite) is rightfully considered as one of the best in the world. Average analysis (dried) is shown in the table. The deposits owned by Vale do Rio Doce are estimated to contain reserves of approximately 2,000,000,000 tons. The three deposits under active development are known as Cauê, Dois Corregos and Conceição.

Cauê, which means the "stone that shines," is the most important deposit of all. Its exploitation is entirely mechanized and follows standard open pit methods. The two other deposits (Dois Corregos and Conceição) are mined by semi-mechanized processes.

The Cauê ore body lies at the top of a mountain of iron ore which was originally 4,200 feet high. It is now about 4,125 feet high. The ore con-

Hanna Studies Development of Major Mine in

Located in the heart of Quadrilatero Ferrifero and just on the outskirts of Belo Horizonte, Brazil, a city of 500,000 population, a promising iron ore deposit is under careful investigation by The Hanna Mining Company. Development plans have not taken shape and depend on the results of both economic surveys of mining and marketing and negotiation of suitable arrangements for development with the Government of Brazil. It is believed, however, that this deposit, known as Aguas Claras, could be brought into production within a two to three year period if a decision were made to proceed with mining.

The Aguas Claras deposit, together with other mineral properties, was acquired when Leo Model & Associates of New York and The Hanna Mining Company assumed a controlling interest in St. John de'l Rey Mining Company, Brazil's leading gold producer (see March and April 1958 MINING WORLD).

The itabirite formation (banded specular hematite-quartz) at Aguas Claras is typical of the Quadrilatero Ferrifero. It contains soft, weathered portions and masses of high grade ore, similar in characteristics to ore now mined and shipped by Vale do Rio Doce. The high grade sections of Aguas Claras could be expected to exhibit the same physical and chemical properties as the mines of other producers in the remarkably uniform iron ore formation of Minas Gerais—for example, a grade of 63 percent iron (wet), silica below 1 percent, and low sulphur and phosphorus.

The Aguas Claras is on the overturned limb of a synclinal structure. The ore dips at angles of 45° to 60° from horizontal. The deposit is favored with only small amounts of

Beneficiation

sists of a mixture in varying proportions of a hard high-grade hematite with softer fines some of which is high grade (63-66 percent iron).

The ore is drilled, blasted, loaded by power shovels into trucks and hauled downhill to the primary crusher where it is reduced to eight inches and screened at ¼-inch. Fines are stockpiled at a separate area. The lump is conveyed to a secondary screening plant, and after additional screening, it is conveyed to the loading bins.

The primary crusher plant consists of two identical units. The loaded trucks dump into shallow pockets from where the ore is fed by pan-feeders over a grizzly into 48-by 60-inch jaw crushers. From the crushing plant the ore is conveyed by two inclined belts to the top of the two-unit screening plant. Here it passes over double-deck screens.

The ore is then loaded into 50-ton railway cars. It takes about 50 seconds to load a 50-ton ore car. The trains transport the ore to Vitoria, a distance of 356 miles.

At Dois Corregos and Conceição the ore is crushed by hand and transported by aerial cable-way to the car-loading bins. The aerial cable-way has a total capacity of 300 tons per hour. Production at the Dois Corregos and Conceição deposits alone is expected to reach 1,500,000 tons of lump ore in 1960. Up until a few years ago all the ore from these deposits was carried to the car loading point in a fleet of small trucks. Installation of the cable-way systems has brought about substantial savings in transportation costs and has reduced maintenance expenses to a considerable extent. Dollars which had to be used to purchase Diesel oil, gasoline and replacement parts are thus spared to meet other requirements.

SECONDARY SCREENING PLANT is built in two sections, screens out minus ½-inch materials from Itabira iron ore, one of the world's best. Vale do Rio Doce now has large accumulation of fines which it will eventually process for shipment.

The Armour Research Foundation, Chicago, Illinois, has conducted a techno-economic study of Brazil's itabirite iron ore deposits under the sponsorship of Companhia Vale do Rio Doce, S A. and the Brazilian Development Council. Itabirite is a friable type of ore which exists in incredibly abundant quantities in and around the deposits of hematite. Analyses made by Armour of a number of different samples of itabirite with an iron content ranging from 46 to 61 percent, showed that the presence of undesirable materials such as sulphur and phosphorus is uniformly negligible.

The company is now planning to start beneficiation of the itabirite ores to enter the blast furnace market on a very large scale. This will be an addition to the 6,000,000-ton program, which will comprise only lump ore and mine-run, or some hematite fines (ore below ½-inch). Demand for hematite fines is growing very rapidly. The company has built a modern handling system at the Port of Vitoria to export such fines. Shipments of fines have exceeded 500,000 tons per year.

The Rio Doce Company ranks among the most successful concerns in South America and today plays an important role in the development of Brazil's economy.

Minas Gerais

overburden (Canga), and lies at an approximate elevation of 1,050 to 1,200 meters above sea level. It is approximately 200 air miles from the coast. Belo Horizonte is linked with Rio de Janeiro by means of a broad gauge railroad. Rail facilities, however, would require some improvements and new rolling stock would be needed to handle increased tonnage if a new project were to move ahead. Port loading facilities are planned on the coast near Mangaratiba southwest of Rio de Janiero to get the ore to world markets.

HIGH GRADE DEPOSIT would involve low stripping ratio, is located on south side of Serra do Curral. Picture was taken looking southwest; ore extends from foreground to left center and beds dip 45 to 60° to southeast (left).

Cerro Bolivar:
The Upside Down Mine

Special attention has been devoted to braking systems for trucks and for ore trains at this famous mine operated by Orinoco Mining Company. Most of the ore is hauled downhill in 90-ton ore cars which traverse a 7-mile, 3.1 percent descending grade to reach the bottom of the hill. The ore cars are equipped with special air brakes that can be charged at the same time brakes are applied. The track on the hill has two reverse-grade runaway spurs with automatic switches that are electronically operated if train speed exceeds 22 miles per hour.

New Production Record

Set by Orinoco at World's Largest High Grade Iron Ore Mine

Largest single producer of high quality iron ore in South America, Orinoco Mining Company smashed all of its previous records and shipped a total of 14,556,022 metric tons of iron ore from the Cerro Bolivar operations in Venezuela during 1959. A 100 percent owned subsidiary of United States Steel Corporation, Orinoco estimates a 1960 production of 15,000,000 metric tons.

Development of Cerro Bolivar and the lesser known surrounding mines of Cerros Altamira and Toribio required the dredging of river routes and construction of port facilities, two cities, a 90-mile highway and 90-mile standard gauge railroad. The discovery and development of Cerro Bolivar followed an extensive survey of available world iron sources by U.S. Steel. The first ore was shipped in 1954, and late that year the product reached the initial planned rate of production of 5,000,000 metric tons per year.

The ore is a mixture of hematite and limonite with only sporadic occurrences of magnetite. It is relatively free from objectionable impurities, but contains a high percentage of fines. While the ore makes a high quality blast furnace feed, it does not command the high price paid for Brazilian and Swedish "open hearth" ore.

The Cerro Bolivar mine accounts for practically of all of Orinoco's production, although the Cerro Altamira and Cerro Toribio mines contribute 800,000 tons-per-year to the total shipped by the company.

Cerro Bolivar, a hill 7½ miles long and 2½ miles wide, stands out as a landmark 75 miles southwest of Puerto Ordaz. Its highest point rises approximately 1,800 feet above the surrounding savanna to an elevation of 2,605 feet above sea level. The ore is encrusted on the top and upper slopes of the hill and is practically free of overburden. The orebody is long and narrow. It measures 4 miles in length and has a maximum thickness of 585 feet. Average ore thickness is 230 feet. Proven reserves on Cerro Bolivar have been estimated at 400,000,000 tons.

Six electric shovels with either 8 or 9 cubic-yard dippers, and one 6 cubic-yard Diesel shovel, each with a potential capacity of 1,000 tons-per-hour, operate in separate areas on 15-meter (49.2 feet) benches throughout the length of the ore-body. These shovels load the ore directly into 90-ton ore cars, or load into 38-ton capacity ore trucks of a fleet of 35, which in turn dump into the railroad ore cars from loading ramps.

Ore hauling trucks are fitted for down-grade speed control with a retarder system, independent of and in addition to the standard hydraulic wheel air braking system. The company now has eight 50-ton (short ton) trucks in its haulage fleet. They are not being used on Cerro Bolivar because of the relatively short haul involved, but are employed on the Altamira-Rondon and Arimagua concessions. Seven new 50-ton trucks are on order as the company is experimenting with the idea of using two trucks to fill a 90-metric ton railroad car instead of the original three 38-ton truckloads per railroad car.

Rotary drills principally, with percussion and churn drills, supplemented by smaller percussion drills, are utilized for blasthole drilling. Average spacing of the 7⅞-inch diameter holes is 4 by 5 meters, and the holes are drilled 2 meters below grade. Average explosive factor is 0.34 pounds per ton.

At the 15,000,000-ton annual production rate, the mine loads about 625 ore cars per day. Each day five 125 car trains with four mainline locomotives travel the 90-mile standard gauge single track connecting Cerro Bolivar with Puerto Ordaz.

For economy a central traffic control system was installed, with electric battery-operated switch controls activated by coded-pulse V.H.F. radio transmissions. This in effect permits operation approaching double-track capacity.

Maximum track curvature on Cerro Bolivar is 12° and on the savana 3°. The 132-pound rail was designed for 80-kilometers—(49.7 miles) per-hour operation. This gives a possible complete round trip running time of about eight hours.

The 6,000 long-ton-per-hour ore handling and loading system at Puerto Ordaz envisioned centralized crushing and loading of ore from Cerro Bolivar and from other Orinoco concessions in the area. At the receiving area, the 90-ton cars are dumped at the rate of 67 per hour. The ore is

ORE TRAINS are loaded directly by shovels, or in some cases, by trucks which dump into cars from loading ramps. In trip to Puerto Ordaz, 90 miles away, the ruling grade is 0.2 percent, though some short stretches may reach 0.5 percent.

taken through primary and secondary gyratory crushing. Final ore gradation is 45 percent minus-20 mesh and a maximum size of 5-inch lumps. A conveyor bridge places the ore in a 1,300,000-ton capacity storage pile.

From 1954 to 1959, the channel in the Cano Macareo was used for shipments of ore to the sea.

Despite continuous dredging to maintain the Cano Macareo channel, ships' draught were limited. Most ships departed Puerto Ordaz only partially loaded, thus raising costs.

Orinoco engineers spent 33 million bolivares (3.33 bolivares to one U.S. dollar) experimenting with a new route down the Rio Grande to the Boca Grande. The principal task was to dredge and maintain a 30-foot crossing over the 26-mile bar where the Orinoco River empties into the Atlantic, a feat never before accomplished. This was successfully accomplished and tests convinced the company that the river was navigable the year around. With the approval of the Venezuelan Government, the Cano Macereo was abandoned and the Boca Grande placed in use in last year. The new route runs 187 nautical miles from Puerto Ordaz to the sea and a standard 30-foot draught has been maintained for ore carriers.

Orinoco ore is shipped throughout the world. Sixty percent of the production goes to the parent company, U. S. Steel, and 40 percent to customers in Venezuela, the United Kingdom, Germany, Italy and Japan.

NEW OPEN PIT MINE has been in production only since autumn of 1959, is located in Andean foothills of Peru, and will develop magnetite shear zones in granodiorite.

BENEFICIATION PLANT now treats coarse ore by magnetic cobbing, but installation for treatment of fines is under consideration. Ore is delivered to stockpiles.

Open Pit Iron Ore at Acari

Will Soon be Supplemented by New Underground Mine

South America's first underground iron ore mine is being developed by Pan American Commodities, S. A. at the Acari property in Peru, 500 miles south of Lima. It will be a fully mechanized mine incorporating sublevel stoping and drilling methods. The ore will be collected at box-holes and mucked by Eimco 105 overcast loaders into Koehring Dumptor trucks for transport through 13 by 13-foot headings to the portal. The ore is in a steeply dipping vein averaging 27 feet in width and will be mined in blocks 200 feet high.

Acari is the newest iron ore project to reach production in South America, and ore is now being produced by open pitting at the rate of 110,000 long tons per month. Pan American, a Peruvian company, plans to increase this output gradually to 3,000,000 tons per year. In addition to open pit development, the project required the construction of a 37-mile long, two-lane, asphalt highway from the mine to the coast as well as stockpiling and ship loading facilities. A crushing and magnetic cobbing plant was built at the mine to process the ore.

Acari ore occurs as magnetite in a series of persistent, isolated, steep-dipping veins in dioritic rocks. Ore mining widths vary between 20 feet and 100 feet, and except for infrequent pinching, the mineralization is continuous in some veins for 3,000 feet along the strike. A north-south, echelon vein pattern, accompanied by parallel fault movement and shearing of the wall rocks is evident. It would appear that mineralization took place mainly through fissure filling accompanied by some replacement of the enclosing rocks. Veins are compact and uniformly high in grade, except for the banding with pyroxenes and host rocks near the lower vein limits.

Veins have been located principally by surface prospecting, trenching, and magnetometer surveys. Several veins have been scheduled for open pitting, and at present, only one will be mined by underground methods.

Open pit mining has been contracted to Wells Cargo Overseas Ltd., a subsidiary of Wells Cargo, Inc. Wells Overseas uses four P&H 2½-yard shovels and 14 Kenworth No. 802 dump trucks on mine benches. Production drilling is done with Chicago Pneumatic track-drills with 600 cubic-foot-per-minute compressors.

Acari ore is beneficiated at the mine through crushing, screening, and magnetic cobbing. Coarse crushing is carried out by a Birdsboro 42 by 48-inch machine. The plant has a capacity of 500 tons per hour and yields a high grade product. Sintering ore will be produced at a later date from the fines rejected by the plant. Currently the plant rejects about 1,500 long tons daily of fines, and present planning is treat this reject by dry magnetic methods without more grind.

Acari trucks the ore to the Port of San Juan, Peru, the same port that contains Marcona Mining Company's ship loading installations. The Acari stockpiling, reclaiming and ship loading facilities were designed by Frederick Snare Corp. with the cooperation of Hewitt Robins, Inc. Ore carriers can be loaded at a rate of 1,500 tons hourly.

Financing of the Acari project was arranged through American Overseas Finance Company of New York and Ore Marketing Corp. of Panama. END

OVER 25 IRON ORE DEPOSITS are controlled by Santa Fe and most are mechanized similarly to the above mine. The ore is shipped to U.S.A., Canada, Japan, Europe and South America.

TWO MECHANIZED PORTS have been built to ship ore abroad. Above installation is located at Caldera and is capable of loading vessels at a rate of 2,000 tons per hour.

Santa Fe Plans Major New Iron Ore Development

Will Also Build 7½-mile Conveyor at Established Mine

Prior to the establishment of Compania Minera Santa Fe in 1952, the major iron ore producer in Chile was Bethlehem Chilean Iron Mines Company, a wholly owned subsidiary of Bethlehem Steel Corporation. In a short period of seven years, Santa Fe has emerged as Chile's largest single iron ore producer and now estimates 1960 output at 3,000,000 long tons.

The ore taken from mines now operated by Santa Fe consists of high-grade, hard, open-hearth and blast furnace types with iron contents ranging from 64 to 68 percent. Through improved port facilities, Santa Fe ore is being shipped at an accelerated rate to various continents, including North America, Europe and Asia.

Overshadowing present facilities, however, is the potential development of the huge El Laco deposit, which Santa Fe has acquired along with a partner, Canadian Foreign Ore Development Corporation Ltd. The El Laco ore bodies are located 200 miles east of Antofagasta and four miles west of the Argentine border.

The El Laco deposit consists of four large ore bodies—Laco Sur, Tuyajto Este, Tuyajto Oeste, and Laco Norte, all within a three-mile radius. The ore lies about 15,000 feet above sea level and it has been reported that total deposits might even exceed 3,000,000,000 tons. High grade outcrop (65 to 69 percent iron) has been estimated at more than 1,000,000,000 tons by mining engineers and geologists.

Preliminary studies of mining, crushing and transportation requirements have indicated the need for a full-scale mechanization program in order to bring this potential project to production. There will be a need for heavy duty drills, shovels and trucks, a minimum of four crushing plants, a combination of conveyor and railroad transport of ore to port, and a 30,000-kilowatt generating plant. The total investment required for production is estimated to be in the neighborhood of $200,000,000. It is believed that a market for an annual 10,000,000-ton output would be required to justify development of El Laco. This project could possibly take shape and be in production by 1965.

Aside from El Laco, major mining operations are now being carried out by Santa Fe in the following five geographical areas: Coquimbo zone; Chanaral; Tofo zone; Pleito zone; and Copiapo-Caldera.

The present mining operations are basically open pit. Initial production generally involves the working of outcrops. As mining progresses, increasing amounts of waste and overburden are stripped and removed.

Drilling is carried out by wagon drills and medium Tracdrills. Loading is by Diesel shovels ranging from 1 to 2½ cubic-yard capacity in larger mines and by front end loaders in smaller mines. Ore has been trucked from the mines either to railroad sidings or directly to mechanized ports. Truck fleet consists essentially of off-highway rear-dump type powered by Diesel engines. Capacity of the trucks ranges from 6 to 30 tons. Diesel-electric locomotives are of the 900 horsepower class and railroad cars are Simmering and Gregg bottom-dump types with 35-ton capacity.

Because of the rapid increase in demand for Santa Fe's high grade iron ore, drastic modernization and mechanization in the mines are being planned and carried out at an accelerated pace. New machinery is being tested in the mines and purchased from all over the world. At Mina Carmen in the Chanaral Zone, a 600 ton-per-hour crushing and screening plant is under construction. Iron ore is trucked from the mine to the plant, crushed, sized and stockpiled by conveyor belts in storage piles for later shipment.

Iron ore, reclaimed by tunnel conveyor, will be fed onto a 7½-mile overland conveyor system to a railroad siding at Desvio Hermotita to be loaded on railroad cars and shipped to the port. Upon completion in late spring, it will become the longest conveyor system ever built in South America and one of the longest in the world. It is anticipated that this conveyor system will deliver approximately 1,000,000 tons of iron ore per year on the basis of eight-hour-day operation.

Santa Fe seems destined to become one of the world's greatest iron ore producers. END

The Remarkable Growth of Minera Santa Fe

Year	*Shipment in Long Tons*
1952	27,000
1953	80,000
1954	170,000
1955	450,000
1956	1,050,000
1957	1,700,000
1958	1,800,000
1959	2,000,000
1960 (anticipated)	3,000,000

Marcona Now Building South America's First

Now the second largest iron ore producer in South America, Marcona Mining Company plans to start operation of the first stage of a $22,000,000 beneficiation plant at San Nicolas Bay, Peru, by October 1961. Initially, the plant will upgrade two types of ore by alternately sending both through a single scrubbing plant and then upgrading one type by magnetic cobbing and the other by a combination of magnetic cobbing and heavy media separation. The magnetic circuits will be interlocked with the heavy media plant so that hematite rejected by magnetic separators can be recovered in the heavy media plant.

Fine grinding and agglomeration facilities are scheduled for addition to Stage 1 of the beneficiation plant, and provision has been made in the basic design for flotation of iron and copper sulphides associated with certain of Marcona's primary magnetite ores at a future date. A future jig and spiral plant may also be included for treatment of secondary fines produced by scrubbing and gravity circuits and also for treatment of primary fines produced during mining.

The construction program, started last month by Utah Company of America (subsidiary of Utah Construction & Mining Co.), will involve new stockpiling and reclaiming facilities at both the mine and plant site. A 2-mile conveyor terminating at a point 4½ miles from the San Nicolas site will also be built. The conveyor together with new roads to and from the belt system will tie the mines to the San Nicolas facilities, a total distance of about 10½ miles. San Nicolas Bay is 11 miles north of San Juan Bay.

The new plant and ore handling project will supplement Marcona's present program for production of direct shipping grades of ore for blast furnace and open hearth; it will ultimately provide Marcona with all of the necessary tools for complete utilization of all of its extensive iron ore reserves; it will give Marcona the means to firmly compete with any iron ore producer in the world for world iron ore markets. The first stage of the new plant will be able to treat 2,600,000 tons of ore per year and will turn out 2,000,000 tons of upgraded product.

Marcona is jointly owned by Cyprus Mines Corporation and Utah Construction & Mining Company.

What the Construction Program Involves

MINE AND HAULAGE

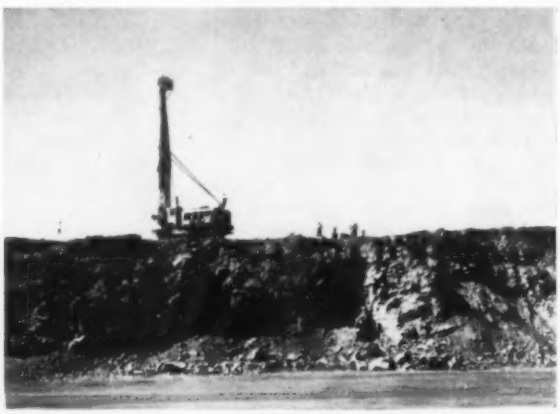
1. Increased stockpiling capacity at the mine.
2. New secondary crusher at the mine.
3. Haul road from the mine to upper or feed end of the new conveyor.
4. Two-mile transport conveyor, lowering the ore 1800 feet in elevation.
5. Haul road from the lower terminal of the conveyor to the San Nicolas plant.

ORE STORAGE AND CRUSHING

6. Truck dumping hopper for crude feed.
7. Traveling stacker for separate stockpiling of three types of ore.
8. Reclaiming tunnel, feeders, collecting conveyor, and dust collecting equipment.
9. Third and fourth stage crushing including screens, dust collection and segregation of sized fractions of ores by conveyors.
10. Storage silos for crushed and sized feeds to Scrubbing and Cobbing and Heavy Media Plants.

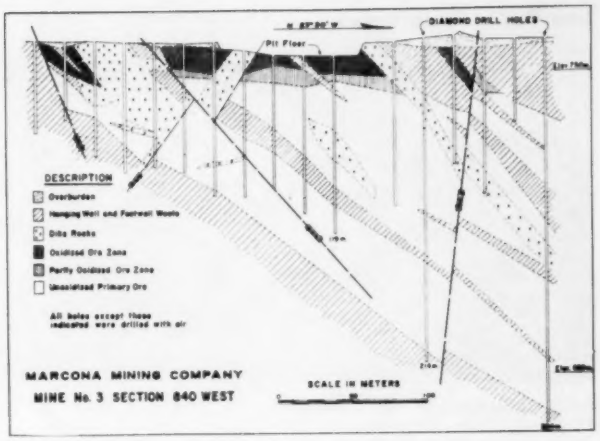
BENEFICIATION

11. Scrubbers, screens, magnetic cobbers, heavy media equipment, conveyors and pumps for material handling.
12. Conveyors, bins and stackers for handling coarse products.
13. Dewatering classifiers and conveyors for handling secondary sands, with slime tailing disposal via launders.
14. Stockpiling and reclaiming facilities for various shipping products.



ROTARY DRILL is boring blast hole in iron ore. Marcona's present production program is concerned with mining direct shipping grades of ore for open hearth and blast furnace. Deposits were first examined in 1906 and were later investigated by several other iron producers. In addition to irregular surface exposures and extensive post ore faulting, numerous intrusions of dacite, andesite and granodiorite indicated that mining would be complicated.

20 ton per hour pilot plant is equipped with spirals, heavy media circuit, and jigs. It was operated for several years, yielded the information for planning of commercial plant.



Marcona mines produce three types of ore in various stages of oxidation. Post ore faulting and irregular surface exposures discouraged early investigators of the Marcona deposits.

Multi-Circuit Iron Ore Beneficiation Plant

Through an agreement with the Santa Corporation of the Peruvian government, Marcona holds extensive reserves of iron ore 10 miles inland from San Nicolas Bay. The company was organized in 1952, built ore handling facilities at San Juan and shipped its first ore in 1953. Production has increased every year and this year the mines are scheduled to produce 4,000,000 tons of ore.

Some 50 different orebodies have been identified in a band some 20 kilometers long and 5 kilometers wide. All produce strong magnetic anomolies and detailed surveys have indicated the presence of many additional zones.

A typical ore body is divisible into three layered zones oxidized to varying degrees. The upper "leached" zone consists chiefly of hematite and is the source of current production. It varies from 20 to 30 meters in depth, is closely fractured, and has a high percentage of voids. This zone merges into a thinner "sulphate" zone, similar in structure, but with fewer voids and higher sulfur content. The proportion of magnetite increases with depth. The lowest zone consists of magnetite accompanied by variable amounts of pyrite in a subordinate gangue of actinolite. This primary ore is black, without voids, uniform in composition and accounts for the major portion of Marcona's reserves.

Marcona has developed seven open pit mines, will develop more as the need arises. Several of the pits have already been joined. Conventional methods of drilling, blasting, loading and haulage are used. The ore is presently crushed at the mine to minus 4 inches, then screened to remove the major part of the minus ¼-inch fraction. Presently mine ore is trucked in 50 to 80 ton Kenworth tractor-trailer units to San Juan, 2,500 feet below the mine elevation. At San Juan the ore is stockpiled, then loaded at 2,200 tons per hour aboard ocean going carriers.

Selective mining must be practiced, and production of direct shipping grades of ore has resulted in the accumulation of stockpiles of mixed ore and waste grading approximately 45 percent iron. Mining will be geared to the production of three types of ore with the completion of Stage 1 facilities at the new plant. Ultimately fines, low magnetic, and high magnetic ores will be handled at the San Nicolas plant. Products of the San Nicolas plant will be loaded onto ships by means of a new pier and ship loading installation to be built at San Nicolas.

The San Nicolas facilities scheduled for Stage 1 operation are shown in the table. Treatment of ore in the facilities is outlined below.

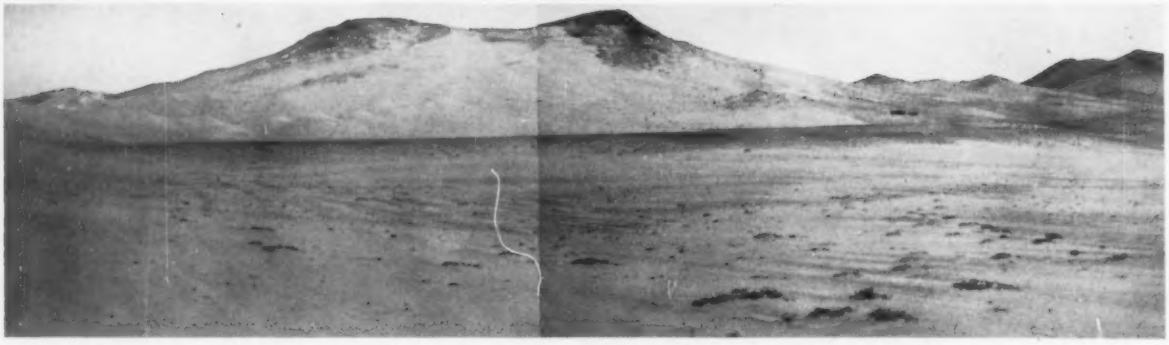
DIRECT SINTERING ORE produced by the mine will involve only crushing in closed circuit through the third and fourth stage to produce minus ⅜-inch material. This ore will be crushed in two stages at the mine to minus 4 inches, delivered to San Nicolas and stockpiled for third and fourth stage crushing. It can then be scheduled through the San Nicolas crushing plant at 335 tons per hour. The crushed ore will then be stockpiled and loaded aboard ships in San Nicolas.

MIXED ORE AND WASTE from mine benches or existing stockpiles will go through two-stage crushing at the mine to produce a minus 4-inch product. The crushed material will be taken to San Nicolas, stockpiled and then fed through crushing and screening units. After the ore is further crushed to minus 2 inches, it will be conveyed to feed silos serving the scrubbing plant. The scrubbed ore will go through heavy media separation and the sink (concentrate) will be conveyed to a stacker and stockpiled on the ground for drainage. An underground reclaim tunnel will draw this ore for delivery to ships. The reject (float) will be conveyed to a truck bin and then hauled to waste disposal areas.

Fines abraded during scrubbing will be dewatered in a spiral classifier and stockpiled for later recovery and treatment at either the existing fines plant in San Juan or in a new plant to be built at San Nicolas.

SCRUBBING AND COBBING ORE will be handled at the mine exactly like the mixed ore and waste. The minus 4-inch material will be delivered to stockpile at San Nicolas. This ore can either be reclaimed and crushed to minus 2 inches or conveyed from the stockpile as minus 4-inch material to the scrubbing plant silos. After scrubbing the ore will be screened into three fractions. The two coarse fractions can be conveyed directly to the concentrate stockpile, or passed over electro-magnetic pulley type separators for magnetic upgrading. Non-magnetic material from the separators can be conveyed to waste, stockpiled for subsequent hematite recovery, or fed to the heavy media circuit for upgrading. Secondary minus ¼-inch fines produced in the scrubber will be dewatered in a spiral classifier and stockpiled or treated as mentioned above.

The proposed master plan for upgrading Marcona's ores will result in one of the most versatile and flexible iron ore beneficiation plants in the world. END



LAS ADRIANITAS DEPOSITS are 15 kilometers north of Copiapo, Chile, and consist of various ore veins and massive bodies which will yield lumpy iron ore. Two ore bodies are the object of initial development, but large blocks of unexplored area remain. Practically all equipment for mining has now arrived in Chile and construction is near completion.

Atacama Readies Las Adrianitas for Mining

Target date for the start of production from Chile's newest iron ore project is mid-1960, reports Cia. Minera de Atacama Ltd. This company is developing the Las Adrianitas deposit, near the city of Copiapo, for an annual production of at least 300,000 to 340,000 tons destined for Japan.

The ore will be mined by open pit methods and transported by truck and trailer over a 60-kilometer road, now under construction, to the port of Calderilla. At Calderilla a modern stockpiling, reclaiming and ship loading installation is nearing completion, and ocean-going ore carriers will be trimmed directly by belt conveyors.

The start of production from the Las Adrianitas deposit marks the climax of a four year survey of potential iron resources on the Pacific Coast of South America by the two Japanese firms Mitsubishi Mining Company and Mitsubishi Trading Company. The survey team was dispatched from Japan in August 1956, and after numerous investigations concluded that the Las Adrianitas deposit was the most favorable for development.

The two Mitsubishi firms entered into an option contract with the owners of Las Adrianitas and began detailed exploration in May 1957. After 1½ years of magnetic surveying and diamond drilling, reserves were considered sufficient to warrant development of the property. The Mitsubishi companies purchased the concession and Cia. Minera de Atacama was formed for the purpose of bringing the property into production.

Two big ore carriers are being built in Japan by the famous Mitsubishi Ship Building Company. The two vessels will consecutively make the voyage from Chile and Japan with the cargo of iron ore produced from Las Adrianitas. END

Iron Mines of Venezuela Ships Hard Hematite

By 1965, it is estimated that the El Pao operation of Iron Mines Company of Venezuela will be mining and shipping 3,500,000 tons of high grade iron ore per year. In regular production since 1951, this affiliate of Bethlehem Steel Company produced approximately 2,600,000 metric tons of ore last year (1959).

The first cargo of Venezuelan iron ore to reach the United States was produced by Iron Mines of Venezuela. The project was put into operation after 15 years of exploration and development at a reported cost of $50,000,000. Preparatory work included the construction of an ore loading station near the junction of the Caroni and Orinoco Rivers; the acquisition of shallow draft river vessels, tugs and barges; the construction of a deep-water port at Puerto de Hierro; and the construction of a 39-mile railroad and parallelling highway to the mine site. The El Pao concession is located about 65 airline miles northeast of the Cerro Bolivar operations of Orinoco Mining Company in Bolivar State of Venezuela.

The El Pao ore is a hard, massive hematite which will range from 63 to 66 percent iron as shipped. It is of the highly desirable type that may be used either in blast furnaces or in open hearths. The main deposit is bowl-shaped formation about 2,600 feet long and 1,700 feet wide on top of a hill rising several hundred feet above the surrounding country. The orebody varies from a few feet to approximately 400 feet in thickness. There are other exposed orebodies within the 20,000 acre concession of Iron Mines of Venezuela which can be mined. It is estimated that the El Pao deposit contains a proven reserve of 85,000,000 tons of ore.

Mining is done by open pit methods in which electric shovels and Diesel trucks are employed. The trucks, equipped with hydraulic retarders, haul downgrade to a crushing plant near the mine. The ore is crushed to minus 3 inches in size, then loaded from a bin into 70-ton railroad cars. Trains are normally made up of 30 to 33 cars for the trip to Paula. The railroad line drops 1,600 feet in the trip to Paula. Of the total trackage, 21 miles is curved and super-elevated; maximum curve is 11°.

At the river installation the ore is stored in a pocket excavated from rock or stockpiled under a 13-ton ore bridge. It is taken down the Orinoco River to the Cano Manamo passage and to the deep water terminal at Puerto de Hierro by barge or shallow draft river craft.

The facilities at Puerto de Hierro, include a flexible pier resting on steel H-piles, unloading towers equipped with 8-ton grab buckets, a traveling boom tripper conveyor feeding an 80,000-ton storage pile, and a 13-ton ore bridge with a span of 320 feet which can build an 1,200,000-ton stockpile.

Manganese

Northwest Guiana Readies Mine

Formed by Union Carbide Corporation, Northwest Guiana Mining Company hopes to start production from a large, but low-grade manganese deposit in British Guiana by mid-1960. The anticipated mining and shipping rate is 10,000 tons per month. Exploration and development was supervised by African Manganese Co.

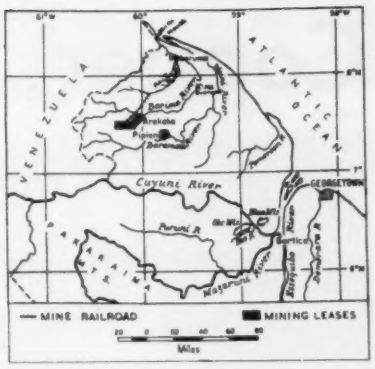
The project will develop for the first time an important manganese source in British Guiana. The reserves near Arakara and Pipiani (see map) are believed to total several million tons. They are located in a remote, practically unpopulated section of the country, and solution of formidable transportation problems had to be overcome prior to development.

The ore will move from washing plants near Arakara over a 38-mile long, 3-foot 6-inch gauge railroad line to a terminal at tide water on the Kaituma River. At Port Kaituma, the washed product will be transferred to vessels of 2,800 to 3,000 ton capacity which will ply the Kaituma river to its junction with the Bairama River. The powered ships will travel the Mora Passage betwen the Bairama River to Waini Mouth, and will unload the cargo of manganese ore at Trinidad where it will be transhipped by ocean-going vessels.

The project had to be literally hacked out of the tropical country. Eminent consultants and specialists in tropical railroad construction, Messrs. Levesey and Henderson, were engaged to locate the most suitable railroad trace.

The contractor appointed for construction of the railroad and necessary dredging of the Kaituma River was Pomeroy International of San Francisco, California. Pomeroy started work late in 1957, completed construction of Port Kaituma and the railroad by November 1959. This was a remarkable effort in view of the fact that construction started from scratch in virgin territory.

The mining will be done by open-pit methods. The ore will be loaded by 1½ cubic-yard capacity shovels and transported to the washing plants by 9 cubic-yard-capacity Diesel trucks. The washing plants will employ primary and secondary crushers, rotary trommels and screens. The washed product will be discharged to stockpiles from which it will be reclaimed and loaded into railroad cars by underground inclined conveyors. The



AFRICAN MANGANESE investigated the orebodies in 1952, found detrital deposits and the underlying beeded ore.

washing plants were designed and supplied by Fraser & Chalmers Ltd. of Erith, Kent, in England.

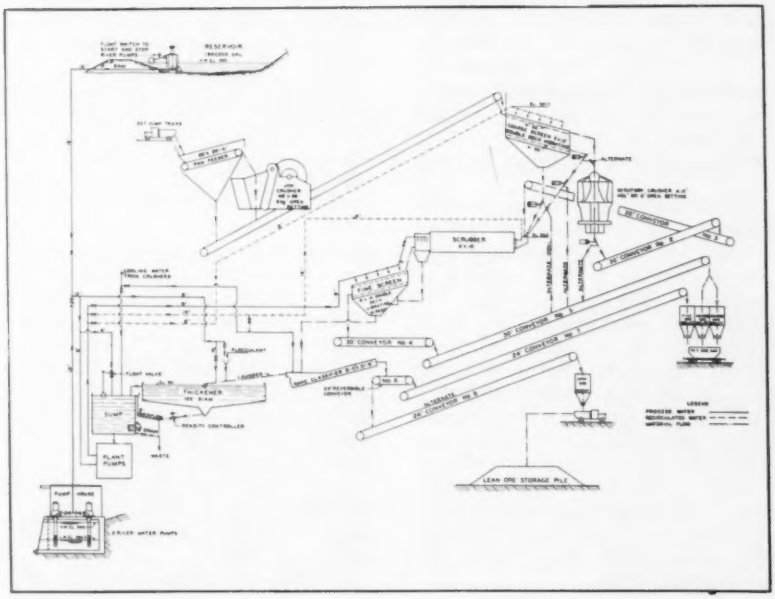
The trains will be hauled to Port Kaituma by Bo-Bo type Diesel electric locomotives supplied by The Yorkshire Engine Company Ltd of Cheffield, England. At Port Kaituma, the cars are unloaded by a tippler and the ore is stockpiled. An underground conveyor reclaiming system, together with surface shuttle conveyors, will be used to transfer the stockpiled ore to the ore carriers.

Manganese occurrences have been noted in British Guiana since the 1870's. Though several reported occurrences were investigated by major mining firms and the United States Geological Survey, none seemed economically attractive for development until recently.

Icomi is One of World's Biggest Producers

The accompanying flowsheet shows the screening and washing plant serving one of the world's largest and most important manganese mines. It is located in the Brazilian territory of Amapá. The mine, developed by Indústria e Commércio de Minérios, S.A. (ICOMI), ships approximately 600,000 tons of metallurgical grade manganese ore per year to world markets. Designed capacity, however, could be stepped up to 1,000,000 tons annually with the addition of more equipment.

Development of ICOMI resulted from the joint efforts of Compahia Auxiliar de Empresas de Mineracao and Bethlehem Steel Company. The project was brought into production in 1957 at an estimated cost of $50,000,000. Washed and screened ore is transported over a 122-mile standard gauge railroad, built as part of the project, to stockpiling and ship loading facilities on the seacoast.



Copper... Two new projects producing

OREBODY is revealed in section of Indio Muerto Mountain. Broken line indicates the 14,000-foot long Inca haulage level between mine and mill. Townsite is at lower left.

ORE IS UNDERCUT AND CAVED in blocks. Chute tapper works broken ore at a draw point on grizzly level into a branched transfer raise which discharges to a haulage level.

El Salvador Mine Will Produce 100,000 Tons

First of two giant South American copper projects recently placed in production, El Salvador operation of Andes Copper Mining Company in Chile, a subsidiary of The Anaconda Company, produced its first high grade copper concentrate in May, 1959. At capacity, the El Salvador project will more than replace the approximate 34,000 annual metric ton production of copper recovered from ore at the Potrerillos operation, which Andes Copper closed in June, 1959.

El Salvador involved the development of a proven reserve of at least 375,000,000 tons of 1.6 percent copper overlain by a thick capping of overburden. The deposit is about 12½ airline miles northwest of the Potrerillos facilities in an area of extremely rugged topography and high relief. Mine layout was planned around a block caving system, which features gravity gathering of ore to haulage levels. Ore is transported laterally on haulage levels to a disposal point from which it flows by gravity through ore passes to the Inca tunnel driven 200 meters below the lower of the two haulage levels.

A mill with a daily capacity of 24,000 tons was designed and constructed under the supervision of Anaconda-Jurden Associates. The latter firm also planned the necessary shops, warehouses and other auxiliary facilities including a modern townsite, which accommodates a population of 7,000.

Development of El Salvador was geared to the decline of production from the famous Potrerillos mine. Existing smelting facilities, which had been provided for the Potrerillos operation, are now used to treat El Salvador concentrate. The Potrerillos smelter, however, required modification to handle the expanded production originating from the new mine. Though the distance between El Salvador and Potrerillos was not great, the topography and other considerations ruled out construction of a railroad connection between the two facilities. Instead, El Salvador concentrate is partially de-watered and piped by gravity at 40 percent solids through a 6-inch steel pipe line a distance of 12.7 miles (20.4 kilometers) to Llanta.

Located in a valley, Llanta is adjacent to a railroad linking Potrerillos with the coast of Chile. Additional de-watering facilities are provided at the Llanta terminal and the concentrate is loaded as a pulp into open gondola railroad cars for transport to the Potrerillos smelter. In the 40-mile distance from Llanta to Potrerillos the railroad rises a distance of 5563 feet (1696 meters). Filtering of the concentrate is done at the smelter.

Chalcocite is the principal copper mineral in the El Salvador ore body and it yields a plus 50 percent copper product on concentration at the mill. In contrast, chalcopyrite was the principal mineral in the Potrerillos ore. El Salvador ore contains insignificant amounts of copper oxides.

Complete delineation of El Salvador ore body prior to full development proved a difficult task. The topography was so rugged that it was impossible to conduct drilling on a regular grid pattern from surface. Thus it was necessary to explore the deposit from underground headings on three different levels. To further complicate matters, the deposit had a somewhat uneven bottom. It was sometimes difficult to predict, on the basis of any

and another is now in the planning stage

PORTAL OF INCA ADIT, 2,000 feet from mill, is haulageway where all mine ore is eventually collected. It is 14 by 17 feet, was driven at average rate of 62 feet per day.

CONCENTRATE PIPELINE is doubled up on steep slopes. It delivers pulp to rail siding for transport to Potrerillos smelter. may later be extended to coast of Chile.

# of Copper Per Year for Free World Supplies

one drill hole from underground headings, whether the hole had probed the bottom or the side of the deposit.

Mine development was planned for gravity disposal of ore with control of the draw exercised by chute tappers on the grizzly level. The sequence of mining is determined by a pattern of standard blocks, which are scheduled in such a way that they are undercut one at a time. A block is 48 meters wide and lengthwise is developed as a series of 12.5-meter panels, each of which contains a grizzly drift through its center. The length therefore is a multiple of the necessary number of 12.5-meter panels to ensure caving with the minimum span.

Panel development consists of a four grizzly raise system which links the haulage and grizzly levels. Each grizzly has opposed branch raises between the grizzly level and undercut level. In other words, a pair of draw raises feeds each grizzly level holing of each of the main raises. The drawpoint dimension of the panel and of the block is 6 by 6.25 meters.

Underground haulage levels for ore gathering are established on 2600 and 2660 meter elevations (mine levels are referenced in meters above sea level). Both of these levels open to the surface for the transportation of men and supplies. Both levels are equipped for 10-ton trolley locomotives on meter gauge.

The Inca adit, which was driven from the opposite side of Indio Muerto Mountain is on the 2400-meter level and is the main egress for ore between mine and mill. This tunnel is nearly three miles long, measures 14 by 17 feet in cross section, and is equipped with 90 lb. rail to handle one-meter gauge rolling stock. The Inca tunnel was driven using a train loader consisting of three inter-connected, 828 cubic-foot cars equipped with a slusher and an Eimco 105, which mucked into the lead car. A record 62 feet of advance per day was achieved in this tunnel.

The receiving area at the primary crushing plant is located about 2,000 feet from the Inca adit portal. Intermediate live storage is provided for both coarse and fine ore.

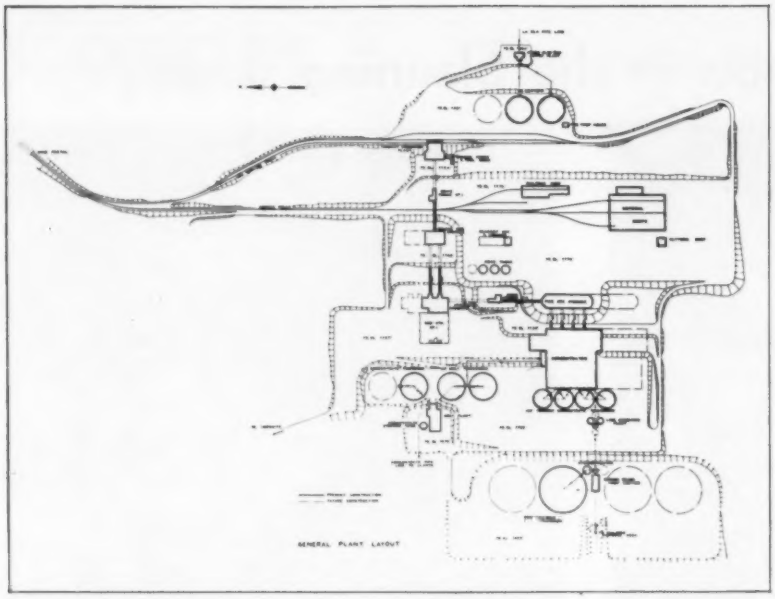
Design Features of the El Salvador Project

By Arthur L. Otto
Project engineer,
Anaconda Jurden Associates

The discovery of the new ore body at El Salvador was indeed timely, for the mine at Potrerillos was rapidly approaching depletion. Feasibility studies influenced by the magnitude and potential of the El Salvador ore body, coupled with the obsolescence of the crushing and concentration facilities at Potrerillos, dictated the economic advisability of constructing a completely new metallurgical plant.

Except for the development of the mine, all of the architectural and engineering design and supervision of construction were handled by Anaconda-Jurden Associates, Inc. of New York, a subsidiary of The Anaconda Company.

The main features of the new El Salvador plant are shown on the General Plan Layout. Aside from being extremely functional, the overall ar-



PLANS FOR FUTURE EXPANSION of present El Salvador installations are shown on the above map. A new smelter for processing of El Salvador concentrated may be built on the coast of Chile at Chanaral.

El Salvador Design

rangement of the plant components results in a simple, cleancut layout with ample provision indicated for the extension of the major units if required at some future time. Expansion of every unit can be accomplished without shutdown, which if not provided for in the design, may be very costly.

Every effort was made in the design to minimize damage from earthquakes, which occur frequently in the area. Among the auxiliary facilities provided for are general shops, car and locomotive repair shops, pattern shop, warehouse, reagent mixing and storage, an oxygen-hydrogen plant, change house, laboratory and offices. In the interest of efficiency and economy, three steel-framed buildings at Potrerillos were dismantled and reerected at El Salvador as shop buildings. These were outfitted with new roof and sidewall coverings.

Concentrate is delivered to the smelter via a 13-mile pipeline terminating at Llanta and then transferred

Toquepala Project Will Yield 150,000 Tons

Southern Peru Copper Corporation's $237,000,000 Program Developed the First of Three Large Porphyry Deposits Held by the Company

The Toquepala project of the Southern Peru Copper Corporation began operations January 1, 1960, and production is soon expected to reach a rate of 140,000 tons of blister copper a year. This is the proud climax to four years of construction work which began in 1956 after engineers delineated the 400,000,000-ton orebody in the Peruvian Andes.

The Toquepala mine has a long history. It is first mentioned in a German geological survey report of Peru around 1800. Later, in the 1860's, French and Chilean miners worked in the area, and the ruins of a French smelter still stand 15 miles north of Toquepala. However, O. C. Schmedeman is generally considered the first to recognize the possible importance of the property. In 1937, while on an exploration trip for the Cerro de Pasco Corporation, he examined the prospect and reported on its low-grade mineralization. From 1938 until 1942, the ore zones and surrounding area of Toquepala were partially explored with adits and drill holes by Cerro de Pasco Corporation.

In 1942, the area came to the attention of the Northern Peru Mining & Smelting Company, a wholly-owned subsidiary of The American Smelting & Refining Company. Northern Peru optioned the Toquepala property and undertook more detailed engineering studies after Cerro de Pasco lost interest. Ensuing litigation over ownership was not finally settled until 1948, when the Peruvian courts ruled against Cerro de Pasco, and clear title to Toquepala passed to Northern Peru and ASARCO.

In 1949, a detailed drilling program began, which by 1954 had delineated an orebody of over 400,000,000 tons averaging a little over one percent copper!

The Toquepala orebody proved to be a rough mushroom-shaped breccia pipe, consisting of a flat-topped, enriched zone of predominant chalcocite progressing downwards to primary chalcopyrite within and around the main pipe. The mineralized brecciated rocks are essentially a complex of basic diorite, dacite porphyry, and other rocks that have been hydrothermally altered by silicification and sericitation. There is no oxide ore and the line between the leached barren oxide zone and the enriched chalcocite zone is sharp and distinct.

In November, 1953, the Southern Peru Copper Corporation was formed by American Smelting & Refining (57.75%), Cerro de Pasco Corporation (16%), Phelps-Dodge Corporation (16%), and the Newmont Mining Corporation (10.25%), to develop and work the Toquepala orebody as well as the adjoining Quelaveco and Cuajone deposits. The Quellaveco orebody is located about 10 miles north of Toquepala, and drilling in 1952 indicated almost 200,000,000 tons of ore of a grade slightly less than one percent copper. The Cuajone orebody, located 10 miles northwest of Quellaveco, was drilled and explored by Cerro de Pasco and Newmont Mining in 1953-55, and is estimated to contain more than 400,000,000 tons of plus-one percent ore.

The Toquepala deposit, being closer to the coast and more accessible, was chosen as the first to be exploited. The first contract—for construction of a pier at Ilo on the Pacific coast—was given to Foley Brothers, Inc., and later construction contracts were signed with the Utah Construction

to railroad cars for a 40-mile haul over existing facilities to Potrerillos. With regard to this concentrate handling system, it is not unlikely that at some future date a new smelter might be built on the Chilean seacoast near the port city of Chanaral. In this event it is conceivable that the gravity pipeline could easily be extended from Llanta to the new terminus, a distance of about 60 miles, with the consequent elimination of concentrate haulage by rail.

The El Salvador townsite is particularly worthy of comment. The focal point is the plaza around which will be situated a church, theatre, bank, commissary and bakery, and private stores. All of these features are within easy walking distance of the homes flanked in "wagon-wheel" fashion around the hub of the plaza. At strategic locations are schools, hospital, athletic field, parks, police and fire stations. The dwellings, for the most part of concrete block construction, are two-story duplex units with three or four bedrooms.

24,000 TON PER DAY MILL is now in operation, has four concentrator sections for recovery of copper and one for recovery of molybdenum. Units in this photograph are keyed to the general plan layout shown on the opposite page.

# of Copper from New Mine, Mill and Smelter

Company and the Morrison-Knudson Company.

Since 1956 over 125,000,000 tons of waste overburden has been removed. This waste was stripped back on 28 benches on the west side of the pit and 13 on the east side, exposing the copper ore on the benches at the bottom.

The 30,000 ton-per-day crushing plant and flotation mill was designed by Stearns Rogers Manufacturing Co. It is connected to the pit by a double track standard gauge railroad. Concentrates from the mill are shipped daily to the smelter at Ilo over a 115-mile standard gauge railway. Rolling equipment for the railway consists of six 130-ton American Locomotive Company electric Diesels plus 80 special concentrate cars. The railroad construction, itself, was a major accomplishment, with more than 7,000,000 yards of excavation and 5,000,000 yards of fill moved for the road bed, which crosses eight major valleys.

Water for the mine and mill is brought from Lake Suche, some 20 miles northeast of Toquepala. Concrete pressure pipe for the 31.6-mile line was manufactured at a special pipe fabricating plant on the pipeline right-of-way. Here, 168,000 feet of 36 and 42-inch, 6,000 feet of 48-inch, and 26,000 feet of 20-inch concrete pipe was produced.

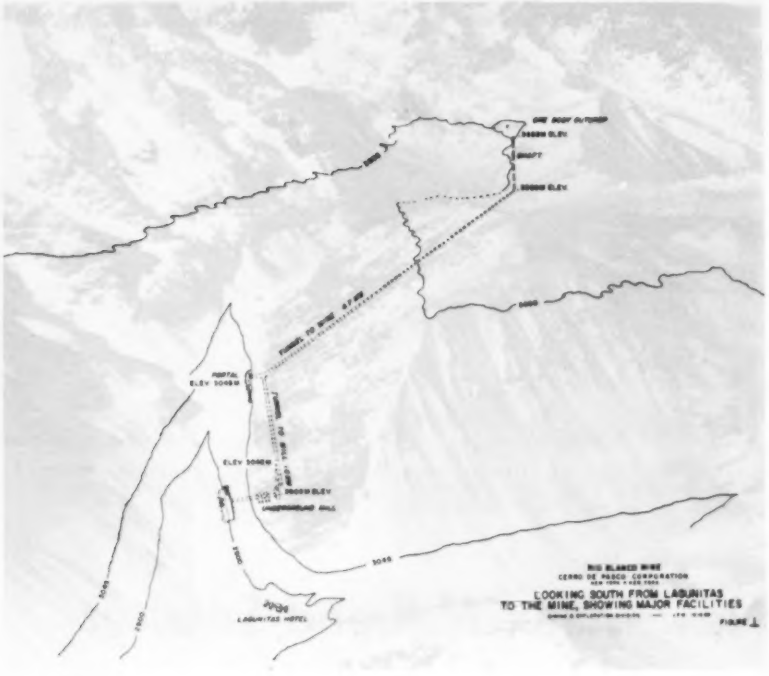
Photo by Ray Manley

NEW MINE required the stripping of nearly 125,000,000 tons of overburden to expose the ore. Operations at Southern Peru began a full five months ahead of schedule, four years after stripping and construction had started.

The smelter, 15 miles north of Ilo, has a capacity of 140,000 tons of blister copper per year. Three 15,000 kilowatt generators powered by oil-fired steam boilers have been installed at the Ilo power plant. The current generated is relayed to the smelter and other operations. A 72-mile transmission line carries power to the Toquepala concentrator.

Operations began at Toquepala five months ahead of the original schedule. To the men and companies who participated in this endeavor, the early completion of the project stands as a monument to their enthusiasm and spirit, and as a symbol of United States and Peruvian cooperation.

Cerro Studies Block Caving for Development



UNDERGROUND DEVELOPMENT is indicated for both mine and mill since altitude of the Rio Blanco orebody in rugged Andes results in very short summer season. Location of proposed facilities is shown, together with adit which will be driven.

An 11,000 ton-per-day block caving operation and an underground mill figure prominently in the plans of Cerro de Pasco Corporation for development of the Rio Blanco copper property, 35 miles northeast of Santiago, Chile. It could become the next major copper project for South America if economic and engineering factors look favorable and if suitable arrangements for development can be negotiated with the government.

Cerro has already spent $2,200,000 on the Rio Blanco and has appropriated another $2,800,000 for further investigation of the deposit in 1960. Core drilling from the surface has indicated the presence of 121,000,000 tons of 1.58 percent copper, though limits of the deposit have not been determined. The next step toward development will consist of driving a 3-mile adit under the ore body from which further exploration of the ore body can be conducted at depth. A shaft sinking program is also under consideration. The adit would be used for an underground haulage link between the proposed mine and mill.

A timetable for the project hasn't been established because market surveys and the supply-demand picture of the copper industry are still under

Mantos Blancos Pioneers Recovery of Copper

By Walter Meckel

Mr. Meckel is general manager of operations Empressa Minera de Mantos Blancos S.A.

A bold project designed to recover copper from a deposit consisting predominantly of the basic copper chloride, atacamite ($CuCl(OH)_3$), will be put into operation in Northern Chile during the latter half of 1960 by Empressa Minera de Mantos Blancos S. A.

This firm, a part of the Mauricio Hochschild organization, will pioneer the application of a patented process at a 3,000 ton-per-day-plant now nearing completion. Treatment will involve percolation leaching of the ore with sulphuric acid. This will be followed by SO_2 precipitation of copper from solution as cuprous chloride in absorbtion towers. The precipitate, after separation from the liquor, will be smelted to yield a high conductivity, fire fined copper.

The total budget for the project calls for an amount of $18,600,000. Of this amount, $9,100,000 was borrowed from several United States banking institutions. This financing was undertaken by International Finance Corporation which is lending $3,100,000. The balance of $6,000,000 is being supplied by Bank of America, American Overseas Finance Company, Chemical International Finance Ltd., and J. Henry Schroder Banking Corporation.

The mine is located 45 kilometers (28 miles) from the port of Antofagasta at an elevation of about 3,000 feet above sea level, which is rather low for this part of the world.

The occurrence of copper at Mantos Blancos has been known since 1913. The deposit was previously worked for only a short period of time on a small scale for high-grade ore. It was optioned by M. Hochschild & Cia., in 1952 and thoroughly churn drilled to prove the first 10,500,000 tons of ore of slightly over 2 percent copper. This was deemed sufficient to justify the erection of a plant to treat 2,000 to 3,000 tons-per-day of ore.

The mineralization consists of copper oxides—mainly the copper oxychloride, atacamite. The gangue rock consists of dacites and andesites which intruded into broadly folded andesite phorphyry lavas of Tertiary age. The surface is covered by a layer of talus cemented together by gypsum and other desert salts.

The several ore bodies lie within an area of 4 kilometers (2.5 miles) in length by 0.5 kilometer (1,640 feet) in width. They extend in depth to below 50 meters (164 feet), and many of the drill holes bottomed in ore. The deposits are blanket-like in shape with irregular outlines of 91 to 183 meters (300 to 600 feet) in length by 45.7 to 91 meters (150 to 300 feet) widths.

The actual scale of operations will be 3,000 metric tons (3,306 short tons) of ore per day by open pit methods. At present, stripping is under way to

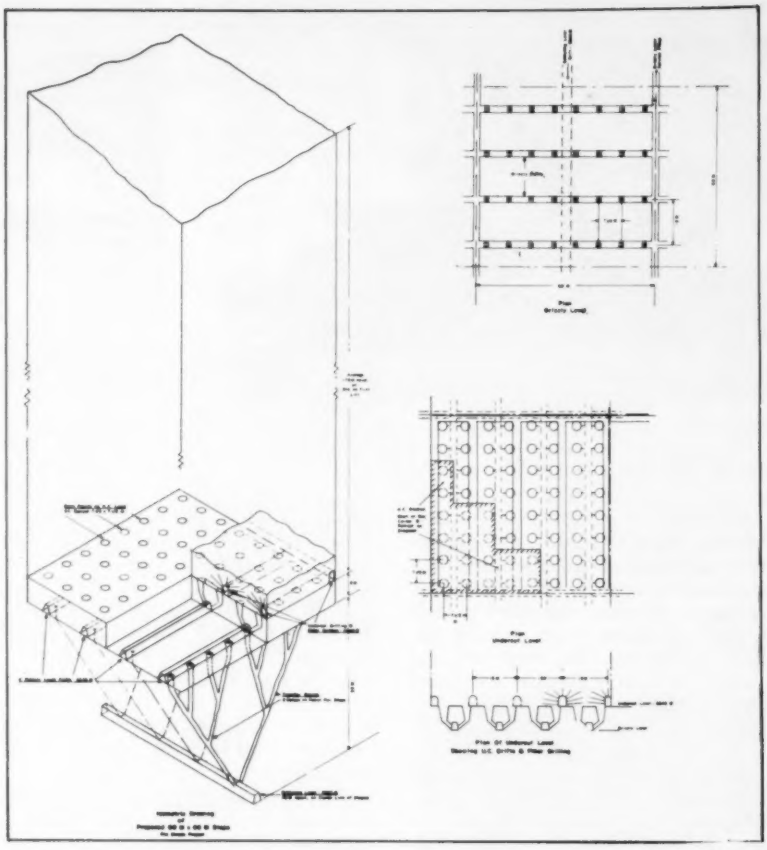
# of Rio Blanco

study. It would take an estimated 2½ years to finish the underground adit and the shaft after they were collared. An additional time factor would be involved in driving block development headings.

Preliminary engineering studies indicate that a sum ranging from $70,000,000 to $90,000,000 would be required to bring the property into production. If the operation were equipped with a smelter the higher figure would prevail; if not, then an outlay of $70,000,000 is expected to cover development and equipping of the mine, the mill, and the necessary service and housing facilities.

Topographically, the deposit might lend itself to open pit recovery of the upper portion, at least, but the high altitude coupled with rather severe weather conditions and up to six months of snow make underground development more attractive.

Design of mine, mill, and smelter has been predicted on an operation with a capacity of about 60,000 tons of copper annually. Though precise plans have not been blocked out, the accompanying picture and diagram show the probable approach to the mining problem based on information now available.



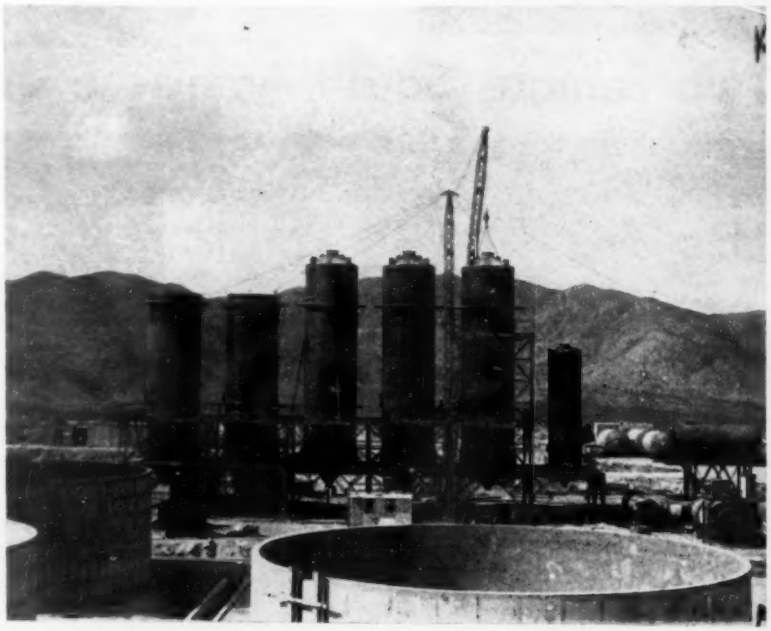
PRESENT THINKING, still subject to change, is to develop the mine in 60 by 60-meter stopes using branching transfer raises which hole the grizzly level between pairs of draw raises. About 2520 square meters of undercutting is involved.

Chloride Ore

prepare the first benches; overall stripping ratio will be 0.8 to 1. Benches are planned for 12 meters (39.3 feet) height.

Mining equipment consists of two Diesel powered 2½ cubic-yard and one 1½ cubic-yard P&H shovels, three D-7 Caterpillar bulldozers, an Eimco 105 loader, and seven 25-ton Dart trucks. Drilling is done by two Bucyrus Erie 29-T and two 42-T churn drills. Haulage distance to the plant will average 2.2 kilometers (1.37 miles) on a steady 7 percent downgrade.

Primary blasting is in the experimental stage. To date, prilled ammonium nitrate and fuel oil mixtures appear to be satisfactory. This is prepared nearby at the Rio Loa plant of Compania Sud-Americana de Explosivos, a DuPont subsidiary. It is primed with about 15 percent, by weight, of 40 percent ammonium gelatine. Detonation is by means of I.C.I. Cord tex fuse.



SOLUTION-REDUCTION TOWERS, now nearly completed, will contact pregnant acid solution with SO_2 to precipitate cuprous chloride for smelting. LURGI delivered the metallurgical plant and MIAG built the ore handling and conveying equipment.

STRIPPING OF DEPOSIT is well advanced and mine will be ready for production soon. Above photo shows a P & H 1½-yard Diesel shovel and a 25-ton KW-Dart truck.

STOCKPILES WILL BE COVERED for protection of ore from the elements. Secondary crusher building in right background will house Nordberg shortheads; primary is Allis Chalmers.

Simultaneously with exploration drilling, metallurgical investigations were undertaken and a pilot plant was operated for over two years. This was necessary because customary metallurgical processes could not be applied to this ore. The high chlorine content of acid solutions precluded electrolytic precipitation of the copper because anodes would be attacked, insoluble cuprous chloride is deposited on cathodes, and chlorine gas is liberated to the tankhouse atmosphere. Because of the scarcity of scrap iron in Northern Chile, ordinary cementation methods were not feasible.

The copper will be extracted by percolation-leaching after the ore is crushed to about $\frac{3}{16}$ inches. This unusually fine crushing was found necessary because of the rather fine dissemination of a good part of the copper minerals in the hard and dense rock.

A 36-inch Allis Chalmers primary gyratory and four 5½-foot Nordberg Symons shorthead crushers will prepare the rock in three stages for leaching. The dacitic and andesitic rocks which are of quite different leaching characteristics will be blended and proportioned from two stockpiles.

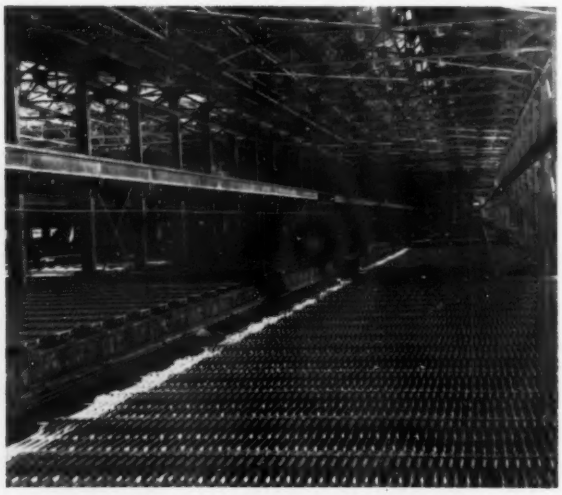
The copper extracted from the pregnant leach-liquors will be precipitated as CuCl by the reducing action of SO_2-gas. While $CuCl_2$ (cupric chloride) is water soluble the CuCl (cuprous chloride) is water and acid insoluble. After the precipitate is separated from the solutions, it will be mixed with limestone and coal. This mixture will then be pelletized, dried and smelted in oil-fired rotary furnaces to a crude copper. The crude copper will be refined by blowing and poling to a product which can be cast into wire bars or ingots of high conductivity metal.

Absence of detrimental impurities in the ore and the chemical refining achieved by separation of pure CuCl from the leach-liquors make it possible to obtain very pure, high-grade copper.

As the ore requires more acid for leaching than is regenerated by the metallurgical process, a separate 100 ton-per-day contact acid plant is being built. Chilean refined sulphur of volcanic origin will be burned to produce the SO_2 requirements both for solution reduction and for the acid plant.

Two Famous South American Copper Producers

EL TENIENTE mine of Braden Copper Company is one of the largest underground mines in the world and was one of the first great copper mines developed in South America.



CHUQUICAMATA TANKHOUSE symbolizes the hydrometallurgical installation built by Chile Exploration Company to treat ore from one of the largest and greatest deposits ever known.

Plant Modernization Program

Helps Braden increase copper recovery

Often called the upside-down mine, El Teniente Mine of Braden Copper Company is an important source of copper for Europe and rates as one of the world's greatest mines. Annual recovery of copper from Braden ores ranges from 160,000 to 191,000 tons.

The mine and milling facilities of Braden Copper are centered at Sewell (elevation 9,000 feet), which is 50 miles southeast of Santiago, Chile. The ore is smelted at Caletones about four airline miles below Sewell on the rugged, western slopes of the Andes Mountains. The smelter turns out either blister or fire refined copper.

The mine is developed for block caving and features long gravity transfer raises. Ore is subjected to attrition during its passage through transfer raises and this has replaced primary crushing of the feed for the mill. El Teniente Mine contains nine levels with two or three levels actively producing ore. The operating levels vary between 7,380 and 9,200 feet above sea level. Teniente 5 is the main haulage level, and the portal of this adit is linked on railroad grade with the ore receiving area of the mill at Sewell.

Mill feed contains just slightly under 2 percent copper. Nominal rated capacity of the concentrator is 34,000 tons per day. The concentrator is built on 20 different levels and consists of a crushing plant, ball mill circuit, flotation circuit, retreatment plant, filter plant and aerial tramway. Grinding is carried out in closed circuit with mechanical classifiers.

In 1958 replacement of old flotation machines with flotation equipment of modern design resulted in improved metallurgy and lowered costs.

NEW FLOTATION MACHINES have repaced old flotation equipment at Braden mill and are more efficient.

The concentrate produced by the mill averages about 33 percent copper. This product is delivered by means of one-ton buckets on an aerial tramway to the mill. The tramway is operated partly by gravity, is equipped with 1.8-inch diameter cable, and contains 150 buckets.

One New Bench Per Year

Developed at Chilex Chuquicamata mine

Certainly one of the world's most important mines, the Chuquicamata operation of Chile Exploration Company in Northern Chile now rivals, in total tons handled daily, the output the Utah Copper Division of Kennecott Copper Corporation at Bingham Canyon, Utah. In terms of total copper recovered from the ore, the Chuquicamata operation is by far the largest copper mine and probably the largest single mine in the world.

Chile Exploration Company, a subsidiary of The Anaconda Company, now moves about 155,000 tons of ore and waste per day. Of this total, 90,000 tons represents the daily output of ore. Copper production in 1958 was 469,000,000 pounds though operations were curtailed by a 50-day strike.

The mine was developed as an open pit which began operating in 1915 to recover vast reserves of copper oxide ore by treatment in a hydrometallurgical installation at the rate of 10,000 tons of ore per day. Guggenheim interests placed the mine in production and controlling interest in Chile Exploration Company was acquired by The Anaconda Company in 1923.

Through the years the Chuquicamata facility has been expanded considerably, and the complexion of the operations has changed. As mining progressed deeper, increasing quantities of sulphide ore were encountered below the oxide layer. It became increasingly difficult to maintain the required output of copper from oxide ore alone, and in 1952 sulphide treatment facilities were placed in operation. These included a new crushing plant, a sulphide flotation mill and a new smelter together with the necessary auxiliary installations. Today the Chuquicamata ore is divided for treatment with about 55 percent of the total reporting to the sulphide plant which has a present daily capacity of 42,000 tons of ore and 45 percent to the oxide plant which is capable of treating 42,500 tons of ore daily.

The Chuquicamata orebody is one of the largest known copper deposits in the world. It has been described by V. D. Perry, chief geologist, Anaconda Company, as an elongate, dike-like body of monzonite porphyry surrounded by granodiorite and older formations. The ore zone is confined principally to the porphyry but copper mineralization shows gradational boundaries between porphyry and surrounding granitic rock. The oxide body is confined to the central and eastern zone and is separated from underlying enriched copper sulphides by an irregular layer of iron oxide waste. Open pit operations will continue for years to come, but when the day arrives that the economic open pit limit has been reached, mining will probably go underground.

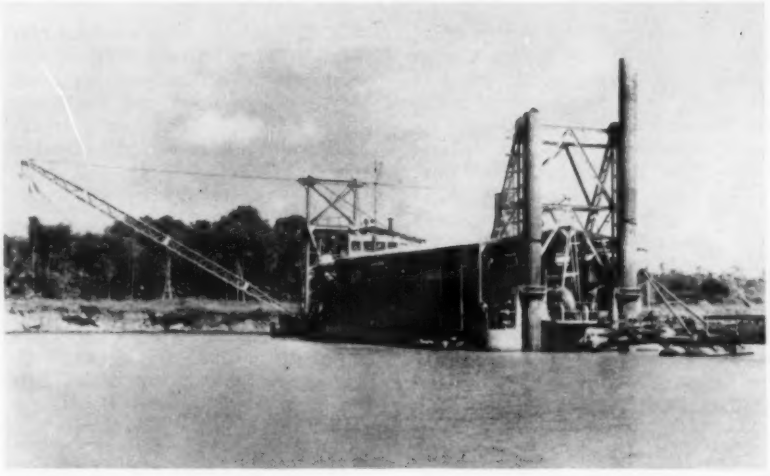
RAILROAD HAULAGE is primarily used at Chuquicamata mine, though some trucks are used on upper benches.

From the very beginning Chuquicamata was planned as a railroad open pit mine and equipped with steam shovels and steam locomotives. Steam powered equipment has yielded to progress and presently electric shovels are used along with electric rail haulage. Recent locomotives placed in operation at the pit are equipped with Diesel-electric power plants. Also Diesel-powered, end-dump trucks have been acquired and placed in service on some of the upper benches to handle waste from stripping operations.

In recent years the mine has been developed at the rate of about one new bench per year. Benches are now 53 feet high (16 meters) and tracked with 80-pound rail on standard gauge.

Bauxite . . . Mines try several types of

BROKOPONDO PROJECT will provide hydroelectric power for smelter; and an alumina refining plant will be built.



CUTTER-SUCTION DREDGE is used where overburden is soft and treacherous near Paranam. The dredge has yielded stripping costs of slightly over $0.19 per cubic yard and engineers firmly believe the cost can be improved.

Suralco Plans a Smelter for Surinam Bauxite

A $150,000,000 construction program—the use of a suction dredge for stripping—and a sink-float plant that recovers commercial bauxite from an iron-contaminated feed draw attention to Suriname Aluminum Company (Suralco). This organization, a 100-per-cent-owned subsidiary of Aluminum Company of America, shipped 2,700,000 metric tons of bauxite in 1959, making it the largest producer in Dutch Guiana, and the second largest source of bauxite for the U.S. aluminum industry. Operations are centered at two localities. The Moengo facilities, located about 120 miles upstream from Paramaribo on the Cottica River, accounted for 2,160,000 tons of output. The Paranam facilities, 20 miles south of Paramaribo, produced the remainder.

The construction program, called the Brokopondo development, is a joint venture of Suralco and the government of Suriname. It involves first the construction of a hydroelectric dam on the Suriname River capable of producing 150,000 kilowatts of power. The power will be used primarily for a two-potline aluminum smelter to be built for an annual capacity of 60,000 metric tons of primary aluminum. Target date for completion and initial operation of the two planned installations is 1965. As a third phase in the program, an alumina refining plant is planned and scheduled for completion by 1974.

Two considerations enter into the fact that the smelter is scheduled for completion before the alumina plant. First, there is still some unused alumina capacity available in the United States where the ore is now shipped. When the new smelter is completed in 1965, ships will carry payloads both ways—bauxite ore to the U.S. and return to Suriname with alumina. As aluminum markets continue to grow, the United States alumina capacity for the Suriname smelter will disappear, justifying the construction of new refining facilities at the smelting site in Suriname.

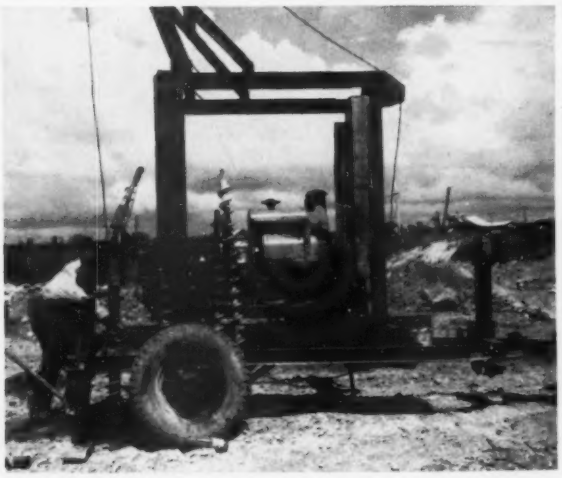
A 50-mile road is under construction linking Paranam with Affobakka, the site of the dam. The dam will create a 600-square-mile lake. A reserve block of electricity produced by the projected dam will be used to serve the city of Paramaribo, now consuming Diesel-electric power. The smelter (reduction plant) will be built at Paranam. In the Brokopondo development, the government of Suriname is responsible for providing necessary lands, access roads, and for relocating inhabitants in the reservoir area. Suralco will supervise road construction; build and operate the power facilities. At the end of a 75-year period, the hydro-electric project will be turned over to the government.

Mining methods developed to recover ore from the high-quality deposits of Suriname Aluminum Company represent an interesting study. The Moengo mines, the oldest producer, are favored with only slight amounts of overburden, occurring mainly as small pockets of waste on low hills. Practically all of the stripping at Moengo can be handled by bulldozers which work the waste into piles. The piles are loaded by small shovels into 15-ton Euclid trucks and Koehring dumptors which shuttle the waste to disposal areas.

The stripped ore, which may be up to 15 feet thick, is drilled by Parmanco gasoline-powered augers and hydraulic-controlled augers built in Suralco's own shops. The gasoline-powered augers put down 4-inch diameter blastholes, and the pattern used is variable depending on thickness of the ore. A 12½-by-15-foot pattern is about the maximum spacing used. The ore is blasted using mainly Gelex No. 1 and No. 5 in 3-inch-diameter by 16-inch-long sticks. Powder consumption is 0.28 pounds-per-metric-ton of ore broken. Tests are under way to determine the effectiveness of ammonium nitrate as a blasting agent to further reduce costs.

The blasted ore is picked up by 2½-yard Bucyrus Erie shovels and loaded into 20-ton mine cars. These cars travel on 36-inch gauge track and, within the pit, are hauled by 35-ton Diesel-electric locomotives. On the mainline beyond the pit, the side-dump cars are made up into

equipment to strip waste from hidden ore



AT RORAC MINE near the Paranma works, Parmanco augers are used to bore blast holes in the bauxite ore. In the above photo, tools are being pulled from a finished hole.

STANDARD MINING PRACTICE is to load stripped ore directly into railroad cars in the pits. The shovel shown in the picture is a 2½-yard Bucyrus Erie unit.

. . . Is Now Stripping Buried Ore With a Dredge

28-car trains. The ore is hauled by these trains a distance of 16 kilometers to the mill. The trains on the mainline are pulled by 50-ton Diesel-electric locomotives.

Prior to 1957, methods used to recover ore at the Paranam deposits were similar to those employed at Moengo except for variations caused by local conditions. The ore deposits that were developed were shallow, though most contained slightly greater amounts of overburden than was the case at Moengo. As a rule, the Paranam deposits were smaller than Moengo deposits. Originally, Paranam operations started on the west bank of the Suriname River. Then, ore bodies were opened on the east side of the river. The east side deposits are expected to be depleted by 1963 or 1964, but reserves have been augmented by discovery of buried deposits on the west side of the river. Methods for stripping the hidden deposits were the subject of intensive study.

A cutter-suction dredge was finally selected as the logical means for removing the soft-to-hard layers of silt, sand and clay overlying a buried lens-type ore body measuring about 2,200 feet by 4,400 feet. This dredge has been working on the Onoribo IV deposit since 1957 and has yielded an average stripping cost of $0.1962 per cubic yard. The Onoribo IV ore body is located in the tidal flat of a river. The stripping project thus required diversion of the river to a new channel and the construction of a spoil disposal area.

The nature of the overburden governed the selection of dredging as the most favorable means of stripping the Onoribo IV. The bauxite zone was covered with varying layers of soft marine clays and medium-firm to hard clays. The soft marine clays accounted for an estimated 60 per cent of the overlaying waste and generally were found near the surface. The firm clays comprised about 20 per cent of the total overburden. They generally occur immediately above the ore. Sand lenses commonly separated the soft clay from the firm clay. These sand lenses together with the surface silt constituted the remaining 20 per cent of the overburden.

Determinations of the bearing capacity of the overburden showed that the soft clay would not support draglines. Tests also indicated that the natural slope of an undisturbed face was very shallow (less than 2½ horizontal to 1 vertical); and the angle of repose of disturbed clay was even flatter (up to 5 to 1). Furthermore, the clay couldn't be de-watered sufficiently to change its physical characteristics or bearing capacity. These conditions ruled out the use of draglines for one cast stripping. The material was also considered too soft to support haul roads for trucks to move the material beyond pit limits.

A combination of hydraulicking to strip the soft layers followed by dragline stripping of the underlying firm clay was also considered, but actual tests proved that even the soft clay was very difficult to get into a slurry for removal by pumping.

The hull of the dredge now in use measures 144 feet by 36 feet, and it draws about 7½ feet of water. It is equipped with a 60-inch-diameter cutterhead on a 79-foot cutter ladder. The dredge pump is a 24-inch centrifugal with a capacity of about 30,000 gallons-per-minute. It is powered by a 12-cylinder, V-type, turbocharged marine Diesel engine rated at 3,200 brake horsepower. Pump specifications called for a capacity of 800 cubic-yards-per-hour of overburden when pumping a mixture consisting of 13 per cent solids by volume through 7,000 feet of pipeline to a terminal elevation 60 feet above the surface of the water.

Normal dredge production amounts to 150,000 cubic-yards-per-month per 8-hour shift. The unit has handled material at a rate as high as 2,500 cubic-yards-per-hour, but this is by no means normal, and depends on the type of ground being worked.

The floating portion of the 24-inch pipeline is made up of 20- and 40-foot lengths of ½-inch wall pipe coupled with ball joints. The shore pipeline, which links the floating section with a spoil disposal area, is

made up for the most part of tapered pipe for cone connections. The pipe tapers slightly to the downstream end and fits inside the upstream end of following pipe section. The connection is made by ramming the pipes by hand or with a bulldozer. Two or three iron straps are welded across the joints on the more permanent parts of the shore line.

The dredge can cut to 45 feet below the water line and has a swing of 250 feet. After the overburden is removed, the pit will have to be dewatered before mining can start. The dredge has operated successfully, and it is felt that in the future costs can be reduced by elimination of certain costly dike construction originally considered necessary for spoil disposal.

Suriname bauxite rates as one of the world's best in quality. The Moengo operations produce three grades of ore. The first is metal grade ore for ultimate reduction to metal. A calcined product, containing 85 per cent Al_2O_3 is mined and sold to abrasives manufacturers. A chemical grade product, containing 60 per cent

N. V. Billiton Employs Bucket Wheel Excavator

To overcome problems associated with the increasing thickness of overburden, N. V. Billiton Maatschappij Suriname has put a large bucket wheel excavator in operation to strip waste from high grade bauxite reserves in Surinam. Built by Orenstein Koppel of Germany, the bucket wheel excavator has been in operation since the Fall of 1959, and is the first unit of this type to be applied in South America. It is used in conjunction with a conveyor system for disposal of waste to mined-out areas of the bauxite concessions.

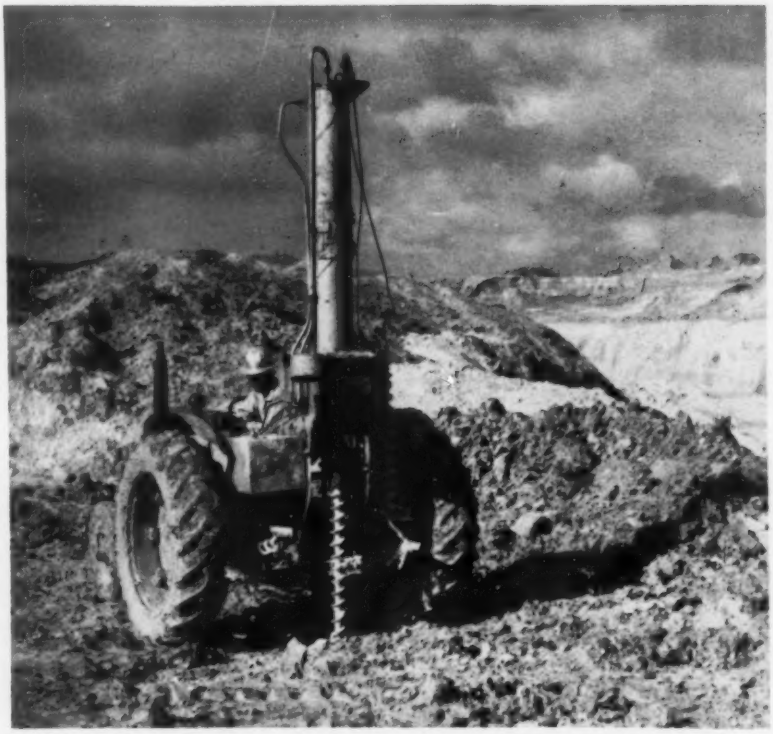
Prior to the application of the new excavator, overburden was handled by two different methods, each adapted to certain types of material. Layers consisting of soft clay and fine sands were stripped by using hydraulic monitors. Firm clays and small amounts of coarse sands were moved by large, heavy-duty draglines.

N. V. Billiton is the second largest producer of bauxite in Surinam. The deposit was discovered in 1939 by a group of Billiton employees. Sixteen months later, the company had accomplished the remarkable feat of placing the property in production and made the first shipment of ore.

The ore deposit that is now being mined is located on the former plantations Onverdacht and Welgedacht. The mine site is 30 kilometers (18.6 miles) south of Paramaribo, a major port on the Suriname River. Drying installations, storage facilities and a shipping dock serving the mines are also located on the Suriname River, seven kilometers (4.3 miles) east of the mine site.

The topography of the concessions is characteristic of a large part of the Surinam lowlands. Marshes and swamps with vegetation are interspersed with somewhat higher and more or less dry terrain. Because of the former plantation activities, not much of the original growth is left. Most of the fairly dry areas, however, are now overgrown w ith a very dense second growth.

The bauxite lies under 12 to 20 meters (39 to 65 feet) of overburden consisting of layers of clay, sand, and marshes. The deposit dips slightly to the north with a consequent gradual thickening of the overburden. The ore deposit has an irregularly rolling upper and lower limit. The shape of the ore body in plan is also quite irregular. Near the edges, the thickness of the ore decreases considerably.



BLASTHOLES IN ORE are drilled with augers mounted on portable units. The Surinam ore is of a very high quality with a theoretical 65.4 percent alumina composition. Iron contaminated layers are usually in the upper section of ore.

Beneath the bauxite layer, a firm white clay or kaolin is found. Immediately above the ore, rather firm layers of clay and sand exist over which it is possible to transport heavy machinery. Extending from the top of the firm clay to the surface, a soft overburden composed of varied layers of soft clay, fine sand, and peat is found.

Before starting operations, the higher areas are deforested by means of bulldozers. The open swamps in the mine front areas are diked-in and pumped out. The mine front is generally advanced as a "left" wing and a "right" wing with a central transport road between the two wings. In one wing, the ore is excavated, while in the other wing overburden is being stripped.

Shallow overburden is conveniently moved by employing hydraulic monitors to disintegrate the soft upper layers. The resulting slurry is gathered and pumped to prepared dumping grounds located far beyond the mine front. After the soft material has been stripped, draglines are employed to strip the harder formations just above the ore. The draglines weighed 600 tons and were equipped with buckets of 15-ton capacity. They were capable of moving the overburden laterally 100 meters (328 feet) and depositing it in an abandoned mine.

Al_2O_3 in the natural, dried state is also mined and sold.

The Paranam ore contains a slightly higher silica content. Only the commercial grade of ore is recovered and shipped from the Paranam operations.

A Wemco HMS plant has been installed to treat some of the high iron-bearing bauxite which has been found inter-layered in commercial bauxite zones at Paranam. This high iron bauxite was formerly considered non-commercial, but HMS treatment has resulted in a recovery of about 50 per cent of this material as a commercial product. In addition, the sink is a saleable product used for road ballast, flooring, etc. The HMS plant, containing an 18-foot diameter separating cone, is operated with a plus-10-mesh feed. A suspension of ferro-silicon adjusted to a specific gravity of 2.43 is used to make the separation. The density of the media is quite critical, because the differential between ore and high iron bauxite is very small. Commercial bauxite is recovered as the float in this installation.

For Stripping Bauxite Deposit in Surinam

BUCKET WHEEL EXCAVATOR is mounted on four large tracks and the structure was designed so that the bearing pressure on the ground is about the same as a human foot. This is a very important factor because the machine weighs over 610 tons and must work in soft material. The excavator was built by Orenstein Koppel of Germany.

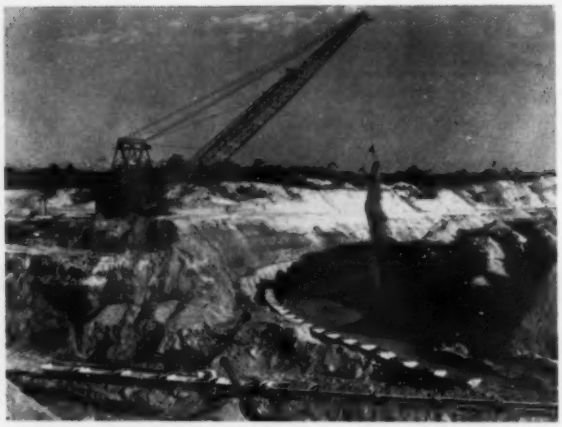
It became apparent, however, that the above methods lacked the necessary flexibility to cope with increasingly thicker overburden. The draglines employed were of the very largest type, but were incapable of throwing the overburden far enough behind the exploitable ore. As a result, the bucket wheel stripping method was developed after careful study of this and alternative solutions.

The wheel excavator is mounted on four tracks which support the revolving superstructure and 20-meter long boom. The bearing surface of the tracks is 66 square-meters and the total weight of the machine is 563,000 kilograms. The resulting ground pressure of the unit is approximately 0.85 kilogram per-square-centimeter, which is little more than the pressure of a human foot. The wheel is slightly over 5 meters in diameter, and it contains seven toothed buckets. Each bucket has a capacity of 200 liters. The excavator is used in conjunction with a conveyor system equipped with 1.20-meter-wide belts which totals approximately 3,500 meters in length. The overburden is transported over this system to depleted sections of the mine.

After removal of the overburden, the ore becomes visible as an undulating layer varying from pink to red in color. The ore is drilled with tractor-mounted augers for blasting. The broken ore is dug by means of small draglines or shovels and loaded into 18 or 35-ton Diesel-driven Tournarockers which feature hydraulic steering. The Tournarockers unload the ore at a washing plant where it is crushed, screened, and washed to remove sand and clay particles. The washed product travels over belt conveyors to hoppers at a rail siding. The ore is delivered by rail to drying and ship-loading installations located at Smalkalden on the Suriname River east of the mine. Special ore tankers of 10,000 to 14,000 tons capacity are loaded at a rate of 1200 tons-per-hour.

The best quality Surinam bauxite has a color range from pink to cream and is rather hard. The principal mineral is gibbsite, which has a theoretical composition of 65.4 percent Al_2O_3 and 34.6 percent H_2O (in the form of water of crystallization). The dried product shipped from Smalkalden is destined for, amongst others, Olin Mathieson plants.

HYDRAULIC STRIPPING has been used with considerable success for economic removal of sand layers overlying bauxite deposits. This method, however, is not effective on clays.



HARD, STIFF CLAYS below sand strata are stripped from ore by walking draglines equipped with 9-yard buckets which handle 13-ton loads. Bauxite is loaded by Diesel shovels.

Traditional Stripping Techniques Are Used by

In certain areas of its British Guiana holdings, Demerara Bauxite Company, Ltd. faces one of the toughest stripping problems confronting any bauxite producer in the world. Overburden to a depth of 150 feet must be moved to expose ore in some cases. The deposits are uncovered by a variety of methods that include the use of hydraulic moniters, sand pumps, tractor scrapers and large draglines.

The construction of a refining plant for conversion of bauxite to alumina is another significant development taking place at Demerara in British Guiana. This project, under way for some time, is expected to be ready for initial production early in 1961.

The Demerara Bauxite Company, Ltd. was established in 1916 and is incorporated in British Guiana with its head office in Georgetown. It is one of several bauxite mining companies in the Aluminium Ltd. group of companies which supply the aluminium industry in Canada and other countries with the basic raw material.

In 1959, the company sold approximately 1,360,000 long tons of bauxite, including 1,000,000 tons of metal grade bauxite and 270,000 tons of calcined bauxites. Demerara first produced special grades of calcined bauxite for the abrasive, refractory and other specialized industries in 1937. The markets for these products have been developed steadily until the company's production and sales of calcined bauxite represent a very substantial proportion of its total bauxite output.

The company's pressing problem of recent years has been to combat rising mining costs due to the increasing inaccessibility of the bauxite available. Mining is done by open pit methods which are conventional at bauxite deposits in the Guianas. A deep sand layer is stripped from the surface by hydraulic mining. The exposed underlying stiff clay is removed by draglines. The utilization of two draglines, each costing more than $1,000,000, has been essential to keep costs within a competitive range.

The stripped bauxite is blasted loose and loaded by power shovels into railway cars for transport to the crushing and washing plant. Approximately 80 miles of narrow gauge railway are maintained and some 40 Diesel locomotives and 600 ore cars are employed. From the crushing and washing plant the bauxite is carried through the kiln drying or calcining process. The dried or calcined product is taken to storage to await shipment from the wharf alongside the plant in ocean-going vessels.

Euclid Loaders Strip Waste from Bauxite Ore

The stripping ratio at bauxite operations of Reynolds Metals Company in British Guiana averages about 3.5 to 1, but the overburden is fairly easy to work and can be handled by Euclid loaders.

Reynolds' British Guiana bauxite mining operations are centered near Kwakwani, about 140 miles upstream from New Amsterdam on the right bank of the Berbice River. The deposits are located in a gently rolling country with maximum elevation about 300 feet above sea level. Primary emphasis in British Guiana is on the production of metallurgical grade ore, but the company also produces chemical grade ore used in the manufacture of alum and other chemical products.

Metallurgical grade ore is currently mined at the Mombaka pit, about seven miles by road from the main barge loading point at Kwakwani. Unconsolidated sandy overburden averaging 30 to 40 feet thick is stripped and hauled to the disposal area. After the ore is exposed, it is drilled, blasted, loaded on Euclid rear-dump trucks and hauled to Kwakwani. Reynolds' haul roads are surfaced with high-iron capping from the top of bauxite deposits. Gravel is not locally available.

Some ore, depending on the source and on the product desired, is loaded directly onto barges; other ores are screened at about five inches, with the oversize passed through a jaw crusher and then loaded; still others are washed before loading. The product is belt-loaded onto 450-ton barges. Reynolds' operates nine of these barges, measuring 120 feet long by 30 feet wide. The barges are of a shallow draft design to clear numerous sandbars in the upper reaches of the twisting river.

The company is completing a short canal from the Berbice River to the washing plant at Kwakwani, enabling its output to be loaded directly onto the barges. Each of the company's three Diesel-powered tugs can push

LONG TRAIN carries bauxite from mine to beneficiating plant at Mackenzie, British Guiana. 54-ton Diesel-electric locomotives can haul 70 loaded cars per trip.

LARGEST SHIPLOADER can deliver dried bauxite to vessels at Mackenzie at rate of 1,000 tons per hour. Ships can be loaded and turned around without missing a tide.

Demerara to Expose British Guiana Bauxite

The company's main installations are located 65 miles up the east bank of the Demerara River at Mackenzie, opposite Wismar. They consist of a group of related mines near Mackenzie and another group about 35 miles away at Ituni, together with a plant for the crushing, washing, kiln drying, storing and ship loading of bauxite. At Mackenzie, the company has built up a planned residential community complete with educational, social and health services and facilities to accommodate a large proportion of its approximately 2,000 employees. At Ituni a second, smaller, but equally self-contained community has been developed.

The bauxite shipped from Mackenzie, in various forms, serves world-wide industry in the production of aluminum, abrasives, refractories, and chemical products.

On December 13, 1956, the company announced its decision to extend its operations in British Guiana by erecting at Mackenzie a new industrial plant which will process bauxite into alumina for export. This plant is now well on the way to completion and will involve the total expenditure of approximately BWI $60,000,000. These funds are being made available to Demerara in Canadian currency by its parent company, the Aluminum Company of Canada, Ltd., which is the principal subsidiary of Aluminium Ltd. Almost $40,000,000 has already been spent on the project, an amount equal to two-thirds of the total amount spent by the British Guiana Government on development projects throughout the whole of British Guiana during the same three years. A further $20,000,000 will be spent in 1960 to bring the new plant to completion early in 1961.

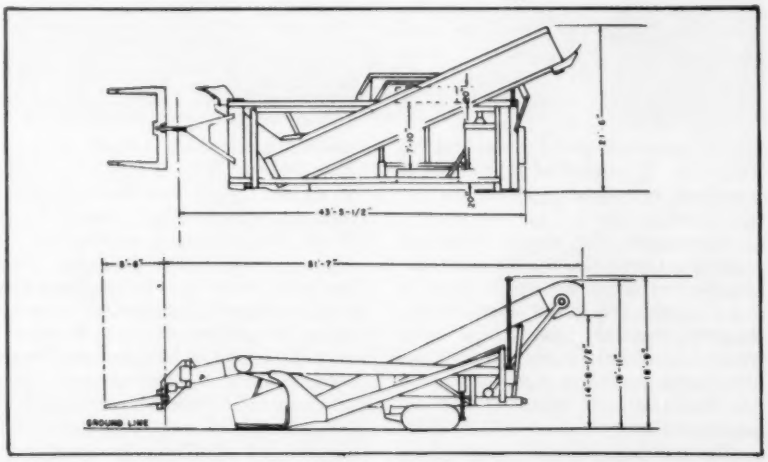
Sprostons Ltd. is another Aluminium Ltd. subsidiary in British Guiana. In addition to owning a foundry, ship yard, dry dock and machine shop, Sprostons operates vessels of its own regular service on the river. It also supplies marine pilots and acts as agent for other shipping companies and for overseas manufacturers. Sprostons represents Saguenay Terminals Ltd, a third subsidiary of Aluminium Ltd, which operates a large fleet of ocean-going vessels that carry the raw materials to the aluminum smelters, the finished product to world markets, and general cargo as return freight. The many ships that come up the Demerara River to take on a load of Demerara's bauxite at Mackenzie are owned or chartered by Saguenay Terminals.

at Reynolds

from one to four loaded barges on the 28 to 30-hour haul to Everton near New Amsterdam.

Because of the thick over-burden, bauxite is rarely exposed at the surface so geological exploration is necessarily conducted largely by drilling. A wide variety of drills are use ranging from man-powered Empire drills to truck-mounted Mayhew rigs.

The dense tropical vegetation and wide areas of swampy ground constitute a major obstacle to systematic exploration. However, new discoveries have added substantial ore reserves which could permit Reynolds to expand its operations when justified by requirements.



MACHINE WITH CUTTING EDGE and self contained conveyor, similar to the above schematic drawing, is used by Reynolds in British Guiana to expose bauxite.

LEAD-ZINC

Open Pit Development Now Underway by Cerro

INCREASED SMELTER CAPACITY is planned by Cerro to bring lead output to 100,000 tons per year from 75,000 tons per year, by adding more Betts process capacity. Zinc output will increase in future from 32,000 to 50,000 tons per year.

McCUNE OPEN PIT will eventually be developed into a major mine which will claim shaft and Paragsha mill.

Long range development of the McCune open pit . . . plant modernization and moderate expansion of lead and zinc refining facilities . . . and continuing exploration of promising copper deposits both in Peru and Chile, highlight the mining scene of Cerro de Pasco Corporation operations in South America.

In Peru, Cerro operates five underground metal mines, one open pit, four concentrators, and a metallurgical works for the smelting and refining of copper, lead and zinc. The metallurgical works which is conveniently located at La Oroya, at an elevation of 12,200 feet, is one of the most complex in the world. In addition to the aforementioned three major metal circuits, companion metal installations have been developed to recover silver, gold, bismuth, cadmium, antimony, arsenic, selenium and tellurium. A number of miscellaneous chemical and metal products are also produced.

To support the above integrated complex, Cerro also operates five hydroelectric plants, two coal mines, a coke plant, 170 miles of railroads, ranches, hospitals, schools, and other related facilities. Recently a new hydroelectric project was completed on the Paucucartambo River. It involved an expenditure of about $30,000,000.

The metal mines now operated by Cerro de Pasco are located within an area of 150 miles by 50 miles, and all are at elevations of 12,000 to 10,000 feet above sea level.

Cerro de Pasco Mine is the largest and most famous of the metal mines. The ore deposits developed at this mine are contained in a lens of pyritic mineralization about 5,000 feet long, 1,000 feet wide and 2,600 feet deep. The crescent-shaped lens lies along the contact of a volcanic plug and limestone. Most of the ore is mined underground, though a small open pit (the McCune) was started in 1956. The McCune open pit now contributes about 20,000 tons of copper ore per month to the Paragsha mill, which also concentrates milling grade ore produced from the underground Cerro de Pasco Mine.

The Cerro de Pasco Mine yields several types of ore. They include copper milling grade and lead-zinc milling grade ores. Copper precipitates recovered by cementation with scrap iron ore are also recovered from drainage water of the Cerro de Pasco Mine. Underground production of copper ore at Cerro de Pasco Mine has been declining somewhat and this trend is expected to continue in order to realize greater efficiency in underground stoping of lead-zinc ore. Stopable reserves of copper ore at Cerro de Pasco mine were estimated at 880,000 tons of 2.2 percent copper, and 2 ounces of silver per ton in August, 1959. Lead-zinc reserves at this mine were estimated at 11,300,000 tons of 5 percent lead, 12 percent zinc and 2.6 ounces of silver per ton.

Above the 600 level of the Lourdes shaft at the Cerro de Pasco Mine there is an indicated large tonnage of low grade material, containing copper, lead, zinc and silver values.

As part of a long range program, the McCune open pit was started at the northern edge of the Cerro de Pasco ore body. The master plan for this deposit is gradually to expand the open pit in three stages. In the first stage, now taking place, copper ore is mined. The primary purpose of this phase is to keep the copper circuit of the Paragsha mill operating at capacity as output of underground copper ore decreases. Other prime considerations include the training of personnel, the formation of an open pit organization and the establishment of benches for expanded operations in the future.

During the second stage, some of the service facilities for the underground Cerro de Pasco Mine will be included within the perimeter of the McCune pit. At this time the open pit will produce both copper ore and lead-zinc ore, and the underground mine will continue in operation. In the third stage, all Cerro ores that can feasibly be mined by open pitting will be taken. During this stage, the Lourdes shaft will be included within the pit limits and the Paragsha mill will have to be moved.

The Casapalca Mine produces copper-lead-zinc-silver ores, which occur in veins in igneous and sedimentary rocks. Reserves in January, 1959, were estimated as 4,100,000 tons of 0.6 percent copper, 3.6 percent lead, 4.5 percent zinc and 8.3 ounces of silver per ton. The Morococha, Yauricocha, and San Cristobal Mines, though smaller than Casapalca and Cerro de Pasco Mines, are important to the total ore production picture.

As still another step toward making up declining copper production, consideration has been given to development of the Cobriza property, which Cerro de Pasco has been exploring. Though little is known of the Cobriza, located 115 miles southeast of La Oroya, it gives indications of being a small, but relatively high grade deposit. Cobriza will probably be developed before the more publicized Antamina property, which Cerro has been investigating in recent years. Work done on the Antamina so far indicates the existence of about 12,000,000 tons of 2.1 percent copper ore, but indications are that Antamina consists of a large low grade deposit. The Cobriza is believed to be of somewhat smaller magnitude, but higher in grade.

With the exception of a certain portion of zinc concentrates sold for export, all of the ores produced by Cerro de Pasco are reduced to metal at the central smelting complex. The company also purchases ore and concentrates from other producers in Peru for treatment at the La Oroya installations.

The complexity of the ores treated by the company has long been a dominant feature of the Cerro de Pasco operations. Over 30 saleable products are recovered at the La Oroya installations. END

Gold-Platinum

South American Placers Airlifts Dredge to Site

BOLIVIA: South American Placers, a wholly owned subsidiary of South American Gold and Platinum Company, placed a rebuilt, 10 cubic-foot bucket line dredge in operation at Teoponte on the Kaka River. The dredge started digging on October 2, 1959 after 3,500 tons of parts had been air freighted approximately 50 miles from the end of the roadway to the construction site. Early in 1960, the dredge will be moved up-river to a large flat at the confluence of the Kaka and Challana rivers.

South American Placers has fully developed reserves of 28,168,000 cubic yards of gravel with an estimated recoverable content of $0.55 per cubic yard. Another 24,202,000 cubic yards of partially developed and potential reserve of $0.384 gravel also exists in the Teoponte area. A promising non-contiguous deposit in the Mairi area may support a second dredge if exploration is favorable.

The Teoponte area so far has yielded gold production that has equaled original expectations based on prospect drilling. Camp installations at the site are nearing completion, and a study to determine whether a hydroelectric plant will be constructed on the Yolosani River is in progress.

South American Placers purchased the original dredge from Bulolo Gold Dredging Company in New Guinea, dismantled it and shipped it by sea to Chile. Parts were shipped by rail to La Paz, trucked over the crest of the Andes and down the eastern side to the end of the road. The airlift got underway in October of 1958. The idle Bulolo dredge was selected because it was immediately available, could be moved economically by air freight, and was designed for very hard digging.

COMPLETED DREDGE is shown in the Teoponte construction pit adjacent to the Kaka River and to the camp. A tri-motored aircraft was used for the airlift which took over after trucks carried parts to the end of the highway.

COLOMBIA: South American Gold and Platinum operated six dredges at the Choco and Narino properties during 1959. Production for the year was 76,900 ounces of crude gold and 17,115 ounces of crude platinum.

Frontino Gold Mines, Ltd., expects to increase production of underground gold ore in Colombia from 17,000 to 20,000 tons per month during 1960. At the end of 1958, Frontino had fully developed ore reserves of 442,272 tons averaging 0.78 ounces of gold per ton. The exploration office of Frontino investigated several gold-quartz prospects and one, close to the Frontino mine, is being placed on a production status.

Frontino is also actively seeking placer ground and will devote most of its exploration activity to this problem during 1960.

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A COMPLETE LINE—85 HP to 150 HP

The new Turbocharged 100 HP No. 112F is designed for high production to match work requirements between the new 85 HP No. 112E and new 115 HP No. 12E. Compared with the 85 HP model, the 100 HP machine delivers 5% higher travel speeds and a 5% increase in blade speed control. With its introduction into the line, Caterpillar now offers you a choice of four Motor Graders in all to meet your specific requirements. The largest is the Turbocharged 150 HP No. 14, the most versatile big grader ever developed.

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Some of the features of the new Cat Motor Graders are described briefly here. But for the complete picture, see your Caterpillar Dealer. Ask him to show you how they're a better buy for your money than ever. Take a look under the hoods at the new modern-design engines. Better still, ask for a demonstration.

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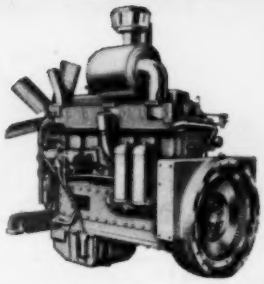
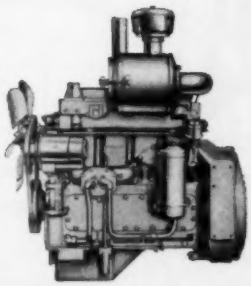


New No. 112E Motor Grader features new compact 85 HP Engine

The new No. 112F is similar in appearance, but features a Turbocharged 100 HP Engine.



NEW HIGH TORQUE. Though the engines in the new Cat Motor Graders are designed specifically for each machine, they all develop higher torque than previous models and have other basic improvements in common. For example: shorter, stiffer blocks and crankshafts... stronger, distortion-resistant cylinder heads... improved cooling systems with greater capacity... engine lubricating oil conditioning... and advanced design fuel systems —new, compact fuel injection pumps with barrel and plunger assemblies in easy-to-service pump housings.

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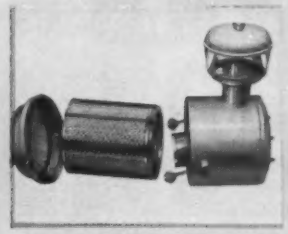
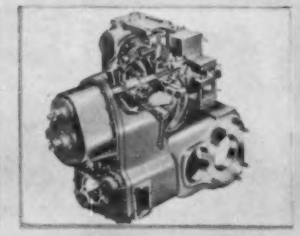
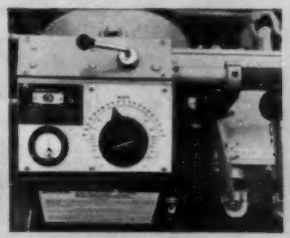
OTHER HIGH-PRODUCTION FEATURES IN CAT MOTOR GRADERS



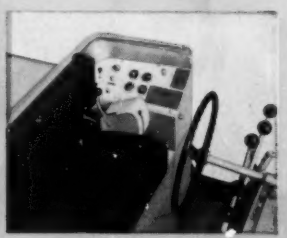
NEW DRY-TYPE AIR CLEANER (standard) removes a minimum of 99.8% of all dirt from intake air during every service hour. Can be serviced in 5 minutes. Cuts your maintenance time by as much as 70% and substantially reduces maintenance costs. Cleaner air also extends engine life.



EXCLUSIVE OIL CLUTCH (standard) provides up to 2000 hours service without adjustment, the equivalent of about 12 months of "adjustment-free" operation. A Caterpillar development proved by millions of hours of use, it virtually eliminates down time for clutch repair.



AUTOMATIC BLADE CONTROL (optional) cuts grading time in half. Operator sets desired slope on dial and only has to control depth of cut. Manufactured by Preco Incorporated, the unit automatically maintains blade slope within ⅛" in 10'. Available factory installed.



IN-SEAT STARTING (standard) offers operator finger-tip convenience and positive starts in any weather. Another feature: improved mechanical blade controls provide precise adjustment and ease of engagement. "Anti-creep" lock makes blade stay put under load.

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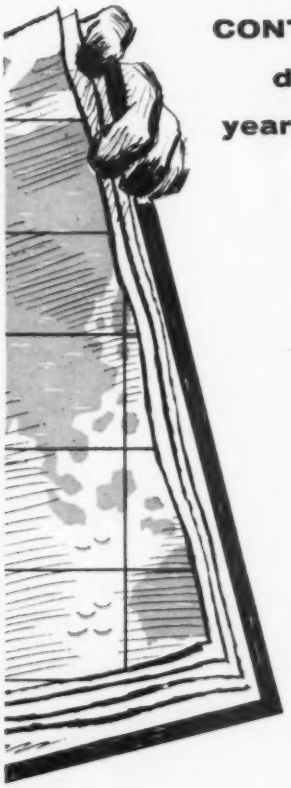
...more than ten million feet drilled in the past ten years. Behind Boyles Bros. leadership in both diamond drill CONTRACTING and the MANUFACTURING of diamond drilling equipment, is more than sixty years of experience.



That's what you get when you buy Boyles Bros service or equipment. Whether it's core drilling, blast-hole drilling — grouting — soil sampling — foundation or oil structure testing. Whatever and wherever your drilling problems are, you'll do better with Boyles Bros.

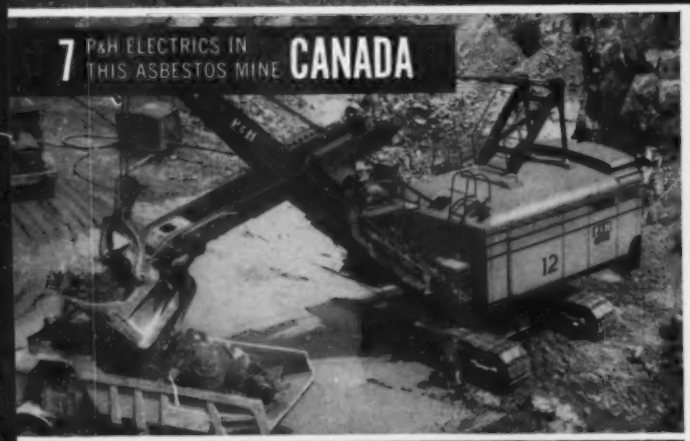
Vancouver, B.C. Head Office and main manufacturing headquarters occupies a full city block. Boyles Bros. drilling equipment, diamond bits and other products specified by drillers everywhere in the world are made at this busy plant. Full range of Canadian and American standard bit sizes. For information and quotations address your nearest location listed below.

WE LOOK INTO THE EARTH

DRILLING COMPANY LTD.

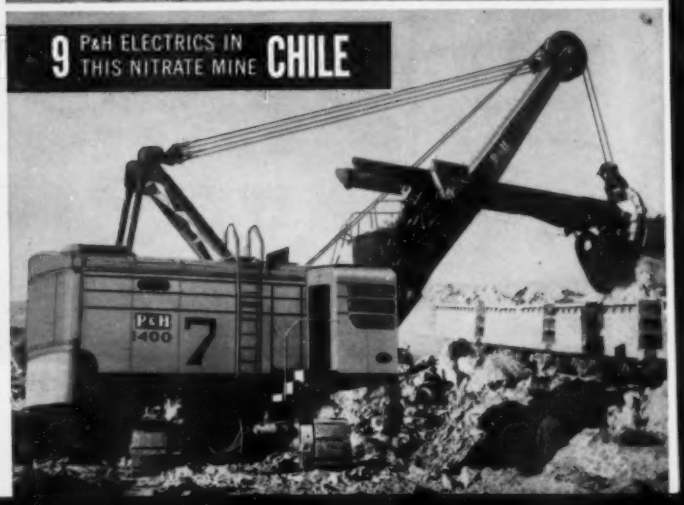
59-62

12 P&H ELECTRICS IN THIS COPPER MINE PERU
12
P&H


7 P&H ELECTRICS IN THIS ASBESTOS MINE CANADA
12

5 P&H ELECTRICS IN THIS COPPER MINE U.S.A.
3

4 P&H ELECTRICS IN THIS IRON MINE U.S.A.
P&H
1400
47


9 P&H ELECTRICS IN THIS NITRATE MINE CHILE
P&H
1400
7

Throughout the Americas...

More mines are STANDARDIZING on P&H ELECTRIC SHOVELS

...more evidence that one P&H always sells another

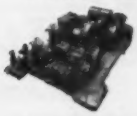
Look at the evidence: Count the P&H Electric Shovels now in use in each of the mines shown here. It's the same story you'll find in mine after mine: once a P&H electric shovel is on the job, performance records show production increases and lower unit costs that simply make it good business to standardize on P&H. Because more mines are following this trend, Harnischfeger now is the world's largest builder of full electric and diesel-electric shovels.

P&H Electric Shovels incorporate many dramatic new design fundamentals which make them different from all others.

Foremost is MAGNETORQUE® drive—the exclusive *patented* hoist drive that puts more material into the dipper, faster—with every pass! It is the most productive digging motion drive known for electric shovels, producing higher bail pull, greater dipper fill factor and automatic impact protection for the hoist machinery.

FIVE EXCLUSIVE P&H FEATURES

MAGNETORQUE DRIVE
Electro-magnetically transmits full digging power of A.C. motor direct to dipper—without motor generator set conversion to D.C. current.



FULL WELDED STEEL CONSTRUCTION
Unit-welded rolled steel design pays dividends in exceptionally long shovel life in hard digging.

ENCLOSED HOIST MACHINERY
No open gearing—all power trains for hoist, swing and propel drives are enclosed in oil-tight gear cases.

INDEPENDENT CRAWLER PROPEL MOTION
P&H gives you independent motors for each function—the basic principle of electric shovel design and purpose.

HIGH STRENGTH T-1 STEEL
Only Harnischfeger uses it as *standard* in fabricating a boom and dipper handle with highest impact absorption ability.

Another major reason why "One P&H Always Sells Another" is single-source responsibility for service. Harnischfeger is the only shovel manufacturer which makes its own electrical as well as mechanical components—all designed and matched by a single manufacturer *specifically for balanced electric shovel production cycles.* For more information write Harnischfeger Corporation, Milwaukee 46, Wisconsin.

HARNISCHFEGER
Milwaukee 46, Wisconsin

P&H
CONSTRUCTION & MINING DIVISION

"FLEXIBILITY AND LOW UPKEEP COSTS MAKE FLYGT PUMPS AN ADVANTAGE," reports LUCKY FRIDAY SILVER-LEAD MINES CO. Mullen, Idaho

While working a 750' shaft-deepening project from the 2300 to 3050 foot level, the Lucky Friday Mine ran into a dewatering problem which required pumping out an average of 150 to 175 gpm. At the start of sinking operations, air pumps were used, but because of periodic extra volume water seepage and excessive repair and maintenance costs, the air pumps were abandoned in favor of Flygt Model B-80L Electric Submersible Pumps.

In the pumping cycle, a Flygt Pump was lowered to the shaft bottom as soon after each blast as possible, and the water was lifted to relay pumps at a higher level, with heads up to 80 feet. The Mine Engineer, in a paper on the operation delivered before the Northwest Mining Convention, said of the Flygt pumping method: "Although the initial cost seemed high at first, the absence of expensive upkeep and the efficient pumping performance justified the investment. The quiet operation of the Flygt was a decided relief after listening to the siren-like air pumps. The Flygt Electric Pump was a distinct improvement over any type of air pump where large volumes of water had to be moved from the shaft bottom. It was low in upkeep cost and its unusual flexibility made it a definite advantage."

Since shaft sinking was completed, two Flygt Model B-80L Pumps now have become a part of the Lucky Friday's permanent mine pumping installation. In service since October 1956, they still are performing with a maximum of efficiency and a minimum of upkeep.

Additional satisfied users of Flygt Pumps in mining applications include Climax Molybdenum Mines in Colorado, Inspiration Copper Mine in Arizona, Kermac Nuclear Fuels in New Mexico, Boyles Bros. Drilling Co. in Utah, Utah Construction Co. in San Francisco, San Manuel Copper Mine in Arizona, White Cap Gold Mining Co. in Nevada, and others.

Flygt Electric, Submersible Pumps range from 1½" 85 gpm to 8" 3100 gpm capacity. Heads to 220'. Higher heads are possible with Flygt Pumps in tandem. Ask today for literature and an on-the-job demonstration.

CHECK THESE FLYGT FEATURES

- Electric
- Resistant to Salt Water
- Submersible
- Easy to Handle
- Low Maintenance Costs
- Will Pump High Amount of Solids
- Heavy Duty
- Operates Unattended
- Runs Dry Without Damage
- Quick and Easy to Service
- No Installation Costs
- No Priming Needed

WRITE FOR NAME OF YOUR NEAREST DEALER

PUMP BETTER ELECTRICALLY

FLYGT

— USE FLYGT!

WESTERN SALES & SERVICE

Stance MFGS. & SALES INC.

1666 Ninth St. (Corner of Olympic & Ninth)
Santa Monica, California

Metal & Mineral Prices

U.S.A.

METALS

April 29, 1960

COPPER: **Electrolytic.** Delivered F.o.b. cars, Valley basis (pound) ..... 33.00¢
Lake. Delivered, destinations, USA ..... 33.00¢
Foreign. Delivered, destinations, USA ..... 33.00¢
Custom ..... 33.00¢
LEAD: **Common Grade.** New York (Per pound) ..... 12.00¢
Tri-State Concentrate, 80% lead, per ton $141.72
ZINC: **Prime Western:** F.o.b. E. St. Louis (Per Pound) ..... 13.00¢
Prime Western: Delivered New York ..... 13.50¢
Tri-State Concentrate, 60% zinc per ton $80.00
ALUMINUM: **Primary 30 Pound Ingots (99.5% plus)** (Per pound) 26.80¢
ANTIMONY: **Lone Star Brand. F.o.b. Laredo, in bulk (Per pound)** 29.50¢
BISMUTH: **(In ton lots) price per pound** $2.25
CADMIUM: **Sticks and bars.** 1 to 5 ton lots Price per pound .. $1.50
COBALT: **97-99%,** keg of 550 pounds (Price per pound) $1.50
COLUMBIUM: **Ingot** ..... Nom., per pound $55.00-$85.00
GERMANIUM: **dioxide, high purity, gram** ..... 18.50¢
LITHIUM: **98%** (per pound) ..... $9.00-$12.00
MAGNESIUM: **Ingots (99.8%)** F.o.b. Velasco, Texas per pound 36.00¢
MERCURY: **Flasks.** Small lots, New York ..... $213.00-$215.00
NICKEL: **"F" Ingots (5 pounds). F.o.b. Port Colbourne, Ontario** 75.50¢
PLUTONIUM: To July 1 1962 AEC will pay $30.00 to $40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram $30.00
SELENIUM: **99.5%, per pound** $7.00
TELLURIUM: Common grade, Per pound $3.00
THORIUM: **per kilogram** $43.00
TIN: **Grade A Brands.** New York (Per Pound) Prompt delivery $0.9912
TITANIUM: **98.3%** + Grade A-1 Sponge (Per pound) ... $1.50-$1.60
URANIUM: **Red (0.790 U-235) $16.00 Per Pound; Foil** $16.75
U-235: **Nominal (Per pound)** $7,725
GOLD: **United States Treasury Price** ..... $35.00 per ounce
SILVER: **Newly mined domestic.** U.S. Treasury price per ounce 90.5¢
Foreign Handy Harmon ..... 91⅜¢
PLATINUM: Per ounce ..... $82.00-$85.00
ZIRCONIUM: **Sponge, Per pound, Reactor Grade** $5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: **10 to 12% BeO. F.o.b. mine, Colorado** $46.00 per unit Small lot purchases at Custer, S. D., Spruce Pine, N. C.,and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $48.00.
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons.
African (Rhodesian). 48% Cr_2O_3. 3 to 1 Ratio .... $35.00-$36.00
African (Transvaal). 48% Cr_2O_3. No ratio ..... $28.00-$32.00
Turkish, 48% Cr_2O_3. 3 to 1 chrome-iron ratio Nominal $36.00-$37.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.
COLUMBIUM-TANTALUM ORE: **Per Pound Pentoxide Nominal** $1.00
IRON ORE: **Lake Superior. Per gross ton Lower Lake Ports**
Mesabi, Non Bessemer, 51.5% Fe $11.45
Mesabi, Bessemer, 51.5% Fe $11.60
Old Range Non Bessemer $11.70
Old Range Bessemer $11.85
Lump: Plus ½-inch $12.85
Fines: Minus ½-inch $10.72
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit ..... $24.00-$25.00
MANGANESE ORE: **Metallurgical grade.** 48 to 50% Mn Long ton unit ..... $0.95-$1.00
Metallurgical grade. 46 to 48% Mn. Long ton unit ... $0.90-$0.95
Metallurgical grade. 44 to 46% Mn. Long ton unit ... $0.80-$0.85
Domestic U.S. Government. GSA Basis $2.30 per unit for 48% mn.
MOLYBDENITE CONCENTRATE: **90% MoS_2 F.o.b.** Climax, Colorado. Per pound Mo, plus container cost $1.25
TUNGSTEN CONCENTRATE: **Domestic. 60% WO_3 Per short** ton unit ..... Nominal $24.00
Foreign: 65% WO_3 Per short ton unit (Scheelite) ... Nominal $18.00
Foreign: South American, Spanish, Portuguese ..... Nominal $17.00
URANIUM ORE. **F.o.b. purchase depot or company mill in accordance** with AEC schedules and company buying contracts. **Basic price is $1.50 per pound of U_3O_8 in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums,** penalties where applicable.

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum **4.25 specific gravity,** per short ton $16.00
BENTONITE: **Minus-200mesh. F.o.b. Wyoming. Per ton,** carload lots $12.50
Oil Well grade. Packed in 100 pound paper bags $14.00
BORON: **technical grade .. F.o.b. Boron California. Per ton** $47.50
FLUORSPAR: **Metallurgical grade. 72.5 % effective CaF_2** content per short ton F.o.b. Illinois-Kentucky mines ... $37.00-$41.00
Mexican. 70% F.o.b. border ..... $26.00-$27.00
Acid Grade. 97% CaF_2, Bulk, F.o.b. mine ..... $45.00-$49.00
PERLITE: **Crude: F.o.b. mine per short ton** ..... $3.00 to $5.00
Plaster grades. Crushed and sized. F.o.b. plants .... $7.00 to $9.00
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas ... $22.50-$23.50

London

April 29, 1960

Per Long Ton USA Equivalent cents per pound*

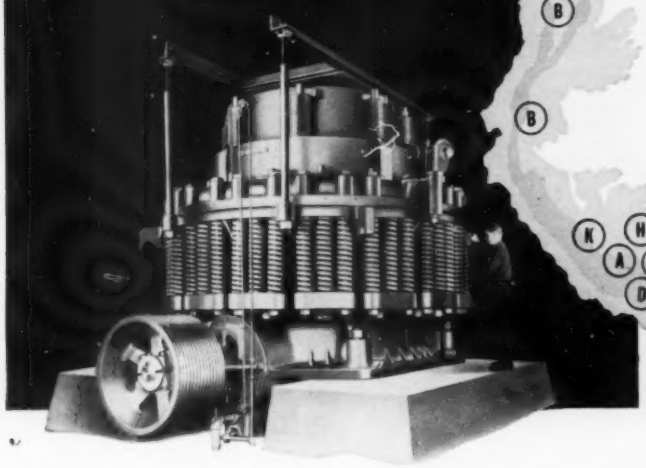
COPPER:	**Electrolytic spot**	£271	0s 0d	33.88¢
LEAD:	**Refined, 99%**	£ 77	10s 0d	9.69¢
ZINC:	**Virgin 98%**	£ 92	7s 6d	11.55¢
ALUMINUM:	**Ingot, 99.5%**	£186	0s 0d	23.25¢
ANTIMONY:	**Regulus, 99.6%**	£197	10s 0d	24.69¢
TIN:	**Standard, 99.75%** ...	£791	0s 0d	98.88¢
TUNGSTEN:	**Long ton unit**	£149s		$20.86¢

***With Sterling Pound at $ 2.80**

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, N. Y.*

SYMONS® CONE CRUSHERS

play important role in processing ores and minerals in *South America*



In all of the important ore and mineral operations around the world . . . Symons Cone Crushers have consistently maintained a preferred position by efficiently processing large tonnages of finely crushed product at low cost.

In South America, scores of Symons Cones are used by leading producers of many of the country's ores and industrial minerals. Included in this group are the well known nitrates and copper ore of Chile . . . the tungsten, copper and vanadium of Peru . . . Bolivia's tin, second in world production . . . as well as the great mineral reserves of Brazil.

The use of Symons Cone Crushers in South America serves as another good example of the way these efficient reduction machines serve the mining and mineral processing industries of the world.

NORDBERG MFG. CO., Milwaukee 1, Wisconsin

SYMONS CONE CRUSHERS
. . . The machines that revolutionized crushing practice . . . **are built in a wide range of sizes, for capacities to over 900 tons per hour. Write for descriptive literature.**

©1959, N. M. CO. M259

NORDBERG

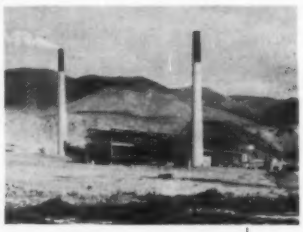
SYMONS . . . a registered Nordberg trademark known throughout the world.

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
SAN FRANCISCO • TAMPA • WASHINGTON • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

PROJECT— COPPER

Another Complete Mill-to-Smelter Plant ENGINEERED by STEARNS-ROGER

This smoothly operating project including copper mill, smelter and power plant was designed to process 30,000 tons per day. The engineering performed by Stearns-Roger included designs for concentrator, smelter, heavy density plant, power plant, crushing plant, and specifications for thousands of items of mill and smelter equipment. Engineering of supporting facilities also furnished includes two complete townsites, public buildings, machine and maintenance shops at mine, mill and smelter, transmission lines and lime plant. Stearns-Roger offers reliability in design, engineering, fabrication, field erection and start-up. One-contract engineering services for your chemical or metallurgical plant project are our specialty.



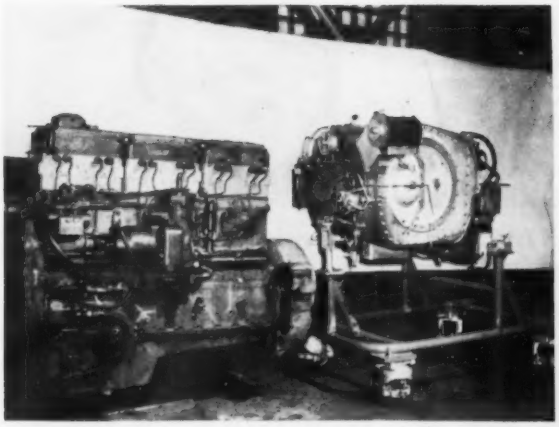
Stearns-Roger
THE STEARNS ROGER MFG. CO. • DENVER, COLORADO

P. O. BOX 5370, DENVER, COLORADO

DENVER • HOUSTON • SALT LAKE CITY
Stearns-Roger Engineering Co., Ltd., Calgary, Alberta

PRODUCTION EQUIPMENT PREVIEW

For data on any item on next three pages use the inquiry card opposite page 74



Gas Turbine To Be Used To Power Truck Hauling Ore from Open-Pit

Another milestone in the development of automotive power was reached with the receipt of a regenerative gas turbine engine for installation in a truck used for hauling ore at The International Nickel Company of Canada, Limited's open-pit mine in the Sudbury District of Ontario. This will mark the first time that an automotive gas turbine engine has been subjected to the rugged requirements of ore hauling.

Called the GMT-305 Whirlfire, the turbine engine was manufactured by the Allison Division of General Motors Corporation. The 225-horsepower multi-fuel engine reportedly has more than double the power of a comparable piston engine per unit volume and approximately 70 percent more power per pound. The negligible oil consumption and multi-fuel capabilities of the engine make it extremely economical to operate. Also, optimum fuel economy is realized at full power.

In many ways, the open-pit mine should prove an ideal testing ground for this new engine since the truck that it powers will have to travel almost two grueling miles over a road winding upward at an 8 percent grade around the inside of the pit walls before reaching the surface with its load of 32 tons of ore. Circle No. 74.

Rugged Wall-Climbing Rough Terrain Truck Has Many Unusual Features

A rough-terrain truck that bends in the middle and is capable of climbing over a three-foot-high wall was demonstrated for the first time by the Clark Equipment Company.

Called the "Flex-Trac," the six-wheeled truck will traverse a 45 degree slide slope, "swim" across rivers, drive through mud, snow, sand or marshland, and speed 56 mph over highways. It was designed as a cargo or personnel carrying vehicle for very rugged terrain.

Unusual operating characteristics of the vehicle, particularly its wall-climbing ability, stem from a unique articulated construction which permits any one of the three pairs of wheels—all of which are drive wheels—to be raised off the ground. Articulation is controlled hydraulically so that the vehicle can assume a "swayback" position, with the front or rear end higher than the center, or an "arched back" position with center wheels off the ground.

In addition to its climbing agility ,the "Flex-Trac" has unusual traction, braking and steering features. All six wheels can be made to turn together regardless of traction conditions at individual wheels.

For amphibious operations, two removable propellers are attached and engaged with a power take-off unit on the transmission. Direction is then controlled by front wheel steering.

Drive train of the "Flex-Trac" consists of a standard six-cylinder automobile engine, a foot operated clutch and two gear boxes which provide thirteen forward speeds and four reverse speeds. Circle No. 76

Motor Scraper Makes Debut

The new TS-360 motor scraper was recently introduced by Allis-Chalmers at special "Premieres" in Florida and California. Under actual field conditions this all-hydraulic 30 cubic yard scraper reportedly demonstrated its ability to consistently obtain loads greater than its rated capacity. Circle No. 89

Twisted Tooth Blades

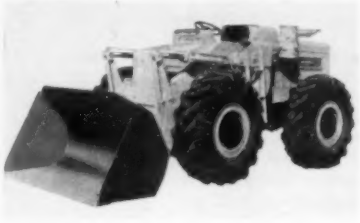
Recent field tests held in Texas lend strong support to the claim that twisted tooth blades increase scraper efficiency. The tests were performed under rigidly controlled conditions, and compared the performance of a twisted tooth blade manufactured by the Shunk Manufacturing Company with a standard straight-edge blade.

Two identical borrow pits of hard clay and sandy clay were staked out for the test. The volume of earth excavated and the distance required to load the scraper were measured and averages computed. The resultant test figures show that loads made with the twisted tooth blade had significant advantages both in general efficiency and in costs. Circle No. 92

Air Escape Mask

Rapid exit from excessively contaminated or oxygen-deficient atmospheres is promised in a new Air Escape Mask announced by Mine Safety Appliances Company.

The eight-pound unit, carried on a nylon harness, is designed for virtually instant operation in emergencies. The demand regulator is incorporated directly into the compressed air cylinder, thus eliminating the need for manual valve operation. With mouthpiece and nose clip in place, the escape mask is ready for service under normal breathing conditions. It provides protection under exertion for approximately five minutes with 6.5 cubic feet of compressed air in the air cylinder. Circle No. 93



Payloader Tractor Loader

The Series B models of the H-70 and H-90 "Payloader" tractor-shovels offer numerous improvements which increase production and better the performance of these four-wheel drive units, according to the Frank G. Hough Company.

While operating capacity of the H-90 series B unit remains at 9,000 pounds, the peak lift has been increased to 18,000 pounds. This model now has a longer wheelbase, wider tread, and additional power provided by a new Cummins Turbo-charged Diesel engine which develops 162 hp at 2,100 rpm. Major improvements in the full power-shift transmission and the torque-converter give superior throttle response and better operating characteristics according to the manufacturer.

The H-70 series B "Payloader" retains the same recommended operating capacity of 7,000 pounds, but peak lift has been increased to 13,000 pounds. Improvements in the boom arm design and bucket control linkage provide additional digging power, especially helpful for below grade work. More power is provided by a larger Cummins Diesel engine which develops 124 hp. Circle No. 97

RESEARCH and EXPERIENCE

SPANG'S

Answer to Improved

DRILLING BITS

After 65 years in the field, Spang research engineers are still constantly working to improve the performance of cable system drilling tools.

This policy of continued research has provided Spang Drilling Bits with:

IMPROVED precision machining of the threaded joint.

LONGER, stronger pin collars.

TOUGHER, sturdier blade sections.

GREATER hardenability potential on the drilling end giving deeper penetration with fewer dressings.

Put Spang Research Experience to work for you—ask for SPANG DRILLING BITS in heat-treated Molloy (molybdenum silicon alloy steel) or heat-treated high carbon steel.

SPANG & COMPANY
BUTLER, PENNSYLVANIA
BRANCHES: Bolivar, N. Y., Mt. Pleasant, Mich., Winfield, Kan., Cisco, Texas

World's Biggest Mobile Shovel

Not for metal mining application but of general interest is a big new 115 cubic-yard shovel to be built by Bucyrus Erie for Peabody Coal Company. Total working weight is 14,000,000 pounds, and the shovel will require over 12,000 horsepower to operate. The machine will be able to pick up 173 tons of materials and dump it 464 feet away. Operation and control of the unit will be facilitated by 52 electric motors from ¼ to 3,000 horsepower. Circle No. 75.

Submersible Drainage Pump

Svenska Motorborr Aktiebolaget of Stockholm, Sweden, has developed a new completely submersible pump that weighs 86 pounds and will put out 265 g.p.m. against a head of 16 feet It measures 10⅝ inches in diameter by 18½ inches high.

The Weda L3 Submersible has an impeller mounted directly on the motor shaft inside the strainer. The impeller forces the water up between the stator housing and the outer housing, and out through the 3-inch rubber-lined discharge hose. Two or more Wedas can be coupled in series for higher heads.

The heavy-duty squirrel-cage motor is totally enclosed and is said to have absolute protection against water. A double shaft seal, plus a stainless sleeve between the rotor and stator, makes it impossible for water to enter the rotor compartment. The water pumped over the outside of the stator housing and through the drilled rotor shaft provides effective cooling. When the pump is idling, the motor is cooled by the air blown through by the impeller. Even if the pump is sunk in deep mud, so that neither water or air can get through, there is no danger of burning out the windings. A new Inherent Overheat Protection system automatically stops the pump. As soon as the pump has cooled and the fault rectified it will restart on its own.

The Weda is salt water resistant and does not require priming. It starts pumping as soon as the strainer is under water and reportedly handles mud and sand easily. Circle No. 81

Improved Microscope

A new research microscope has been announced by Bausch & Lomb Optical Company. The newly designed LR model is said to have even greater research application in such fields as geology, mineralogy, crystallography and physical chemistry than the older LC Petrographic scope.

New coated optic system is reported to give better interference colors, make bi-refringent materials easier to see and provide more sharply defined images and figures. Circle No. 68.

Large Rotary Dryer Shipped to Chile

The Standard Steel Corporation of Los Angeles, California, recently shipped a 52-ton concurrent flow, direct fired rotary dryer to the Chile Exploration Company at Chuquicamata, Chile. This 10-ft. diameter by 60-ft. long dryer was designed and built by Standard Steel and is one of the largest pieces of rotary process equipment ever shipped from the West Coast of the United States. For information and data on rotary drying equipment circle No. 88

27

TYPES AND SIZES

of

ROPE MASTER

SLUSHER BLOCKS

No. 508 — One of a new series designed for big slushers that utilize shaft ropes. Built to withstand the extreme abuse of such service.

ROPE MASTER MINING BLOCKS
ARE AVAILABLE WITH THESE FITTINGS

SWIVEL HOOK
PLAIN SHACKLE
SWIVEL SHACKLE
FLAT TYPE SHACKLE
SAFETY SWIVEL HOOK
SNATCH LOCK

INCREASE WIRE ROPE LIFE—
REDUCE WIRE ROPE COST

PAUL E. KEENEY CO.
1125 S. E. Grand Avenue
Portland 14, Oregon

AT THE MINING SHOW:
BOOTH 202

Up to 4 Times More Slusher Life...

Ore slushers are now hard-faced new, outperform unprotected slushers 3 or 4 to 1. Worn slushers are rebuilt and hard-faced at a fraction of replacement cost.

when Hard-Faced with **STOODY 100**

Modern equipment such as this power-operated positioner handles large parts, cuts effort, speeds hard-facing.

30 year welding veteran prefers semi-automatic welder as less fatiguing, faster and easier. He's hard-facing slusher blades with Stoody 100 in this picture.

The life of a slusher is a tough one! Buckets, bits, blades and shoes are subject to the severest type of destructive wear.

In one of the country's major gold mines it was once common after short service to find half of a 900-pound slusher actually worn away. But not today!

Slushers are now hard-faced, as shown, with Stoody 100 applied by the semi-automatic welding machine. A power-operated positioner allows the work to be turned for easy, fast, downhand welding of all wearing areas. This hard-facing procedure triples or quadruples the service life of the equipment.

The speed and efficiency of the semi-automatic method save two-thirds of manual welding time, get more hard-facing done, do it better, cut costs. An example: Skip car wheels were formerly rebuilt manually in four hours; the semi-automatic machine and rotating positioner, using Stoody 107, get a better job done in twelve minutes...with deposits so smooth that machining is unnecessary.

If you'd like complete information on the savings you can make in your own operations by the use of Stoody alloys—for manual, semi-automatic and automatic application—call on your Stoody dealer. Check the "Yellow Pages" of your phone book. Or write to the company for descriptive literature and the name of your nearest dealer.

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MORE NEW EQUIPMENT . . . AND NEW LITERATURE

ELECTRIC SHOVELS with Magnetorque is said to electro-magnetically transmit full digging power of an A.C. hoist motor direct to the dipper without motor-generator set conversion to D.C. current. Made by Harnischfeger, these shovels also feature electronic control. Circle No. 25.

ATOMIZED FERROSILICON is claimed to offer more abrasion resistance, fewer media losses, reduced pulp viscosity and less equipment wear as a separating media in sink-float systems. It's made by Knapsack-Griesheim. Circle No. 26.

WILLISON CAR COUPLER made by National Malleable & Steel Castings Co. has only four moving parts and eliminates the need for men to go between cars to couple or uncouple. Circle No. 27.

THICKENER BULLETIN has been prepared by Dorr-Oliver Inc. It contains information on the complete line of thickeners made by the company. Circle No. 28.

ELECTRIC BLASTING CAPS: Dupont reports a new series of delay caps is made to fire with a definite time gap between the slowest cap of any period and the fastest cap, eliminating all possibility of overlap. Caps are claimed to provide ample time for rock movement between delay periods. Circle No. 29.

REINFORCED PIPE FITTINGS: New catalog sheet illustrates fiber glass reinforced epoxy fittings for pipe in sizes from one to six inches. Grades are available up to 1,000 psi working pressures, report Ed Conley Plastic Corp. Circle No. 30.

MOTOR GENERATOR CHARGERS: New instruction book, prepared by Exide Industrial Division, The Electric Storage Battery Company, lists time-saving operation and maintenance procedures for automatically controlled motor-generator chargers. Circle No. 55.

STEEL BELT CONVEYOR delivers coal to furnaces, might be useful for feeding other solids to hot openings of converters and furnaces. Belt is made of a band of carbon steel and conveyor structure is mounted on rails so that it can travel from unit to unit. It's manufactured by Sandvik Steel Belt Company. Circle No. 57.

AIR COMPRESSORS: Atlas Copco Pacific has prepared a new folder describing its stationary air compressor line, including data on the Twin-Air rotary screw-type machines which deliver up to 19,400 cfm at 100 psi. Circle No. 58.

SHEAVE BLOCKS: Quick opening blocks of forged alloy steel are described in Bulletin 287-8 by the Joy Manufacturing Company. Circle No. 59.

HOISTS AND SLUSHERS: More than 300 types and sizes of hoists and slushers are described in Bulletin 950-8 recently by the Joy Manufacturing Company. Circle No. 60.

HEAVY MEDIA PROCESS for the beneficiation of metallic and non-metallic mineral ores is described in Bulletin 7110 by Dorr-Oliver Incorporated. The Dorr-Oliver Heavy Media Process represents a significant advance over conventional methods of ore beneficiation. Circle No. 61.

FLOTATION AGENT: A free booklet describing the qualities of Pamak has been published by the Hercules Powder Company. Pamak, fatty acids from tall oil, is useful in beneficiation of ilmenite, kyanite, fluorspar, spodumene, manganese, hematite, phosphate, barite, and cement rock. Circle No. 62.

GYRATORY CRUSHERS: The new TY Reduction Crushers that secure large tonnages of small product of uniform size with low percentage of oversize and waste fines are explained in Bulletin 8112 by the Traylor Engineering & Manufacturing Company. Circle No. 64.

NEW CONCENTRATOR TABLE called the "Super Duty" Diagonal Deck No. 6 offers highest efficiency with minimum loss to tailings and a greatly reduced volume of middlings for recirculation, according to Deister Concentrator Company in their Bulletin 118-C. Circle No. 65.

REPLACEMENT PARTS for crushers, tractors, shovels, and buckets are featured in the new illustrated Bulletin 1063 by the Columbia Steel Casting Company. Circle No. 66.

INDUSTRIAL DRIVE SYSTEM users are being offered a completely new engineering service, providing them an unbiased selection of drives at the most economical cost, according to the General Electric Company. Circle No. 67.

PIPE-FITTING INSULATION: A molded fiberglass insulation called FIT°-rite is described in a new bulletin (TD-105) available free from Fibrous Glass Products, Inc. Circle No. 70.

LOOSE DIAMOND CATALOG: An interesting and informative catalog answering requests for facts about industrial, rough, or loose diamonds is offered by Diamond Tool Research Company of New York. Circle No. 72.

ESTIMATING BOOK: A free 76-page cost and production estimating book is an authentic and complete guide for esti-

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mating material-moving costs, and selecting equipment combinations according to International Construction Equipment. Circle No. 63.

MULTIWALL PAPER BAGS were given thorough comparison tests recently by Clupak, Inc. to determine bag strengths and breakage. Circle No. 1.

NEW RESUSCITATOR developed to aid trapped victims. National Cylinder Gas announces a light weight, rugged unit that works efficiently 200 feet from its oxygen supply. Circle No. 2.

RIPPER for use with International TD-25 crawler permits unit to rip, bulldoze, tow or pushload without changing tools is described in Bulletin GR-160 of the Greenville Steel Car Company. Circle No. 3.

DOUBLE PUMPS have been added to Vickers lines of vane type hydraulic pumps. These new double units extend the range of application by providing one power source for two separate hydraulic circuits or greater volume through combined delivery of both sections. Circle No. 4.

POWER SHOVEL: Full specifications and engineering features are described and illustrated in a new booklet covering the Manitowoc 3-yd. Model 3600 shovel which is also convertible to trench hoe, dragline, crane, and clamshell applications. Circle No. 7.

ROCK BITS: Bottom drive, shoulder drive, and taper socket tungsten carbide bits are illustrated and explained in the new 4-page Bulletin NR-87-C of the Joy Manufacturing Company. A chart provided selection data for all types of bits made by Joy as well as other information. Circle No. 8.

ASPHALT PAVING that contains 2 or 3 percent of short asbestos fiber gives substantial benefits in paving life, performance, and maintenance according to the Johns-Manville Corporation. Circle No. 9.

PORTABLE CORDS AND CABLES are the subjects of a 52-page manual from Kaiser Aluminum & Chemical Sales, Inc. The book gives pertinent data on insulation and jacket compounds plus specifications and characteristics of various types cords. Circle No. 10.

NEW POLYETHYLENE RESIN offers grease-proofness at lower coating weight. New resin made available from U. S. Industrial Chemicals Co., develops maximum adhesion to a wide variety of substrates. Circle No. 12.

RIPPING WITH SEISMIC ANALYSIS is the title of a new booklet just released by Caterpillar Tractor Co. Brochure tells how earthmoving costs can be reduced by the use of crawler-drawn rippers, instead of blasting, in some materials. Circle No. 13.

SINGLE ROLL CRUSHER handles friable material containing noncrushable matter without damage or slowing down. Tramp metal, rocks, stones, etc. pass right through Triumph crusher without slowing or damaging the machine according to C. O. Bartlett & Snow Company. Circle No. 14.

NEW CUTTER BAR AND CHAIN for "Compact" mining machines and "Continuous Miners" is announced by the Bowdil Company. New items are small, light weight and reported to be stronger. Circle No. 15.

WOOD PIPE LINE: Simpson Engineered Wood Products Co. reportedly proved its ability to provide excellent service on a recent project in Michigan, where kiln-dried, pressure-creosoted Douglas Fir was used in the construction of a 10'2" inside diameter wood stave pipeline, 6,050 feet long. Circle No. 16.

NEW REPEATING TRANSIT which combines speed, accuracy, and ease of operation plus the convenience of extra speed of automatic collimation setting is now available in the Wild T-1A model by the Wild Heerbrugg Instruments Co. Circle No. 17.

METALLIC BELT: The Eimco Corporation has announced the perfection and patenting of a flexible, but non-woven metallic belt for use on drum filters. Many advantages are claimed. Circle No. 18.

UTILITY TRACTORS are a new line of equipment just announced by J. I. Case Co. Three new series wheel and crawler tractors with new and higher capacity companion power equipment are featured. Circle No. 19.

SUBMERSIBLE PUMPS that go into the water to provide all-head performance from the bottom require no priming, and have no intake hose or couplings, no check valves, and no suction parts to cause leaks or loss of capacity, are announced by the Flygt Corporation. Circle No. 20.

CONVEYOR BELTING: Mono-Belt rubber conveyor belting is constructed with molded flanges which become an integral part of the belt carcass and cover forming one homogeneous "structure" which reportedly has several advantages over conventional belting according to the Mercer Rubber Co. Circle No. 21.

BELT CONVEYOR IDLERS are described in a new 48-page engineering and product information booklet just issued by Hewitt-Robins Inc. Bulletin 171 gives details on construction, comparison of competitive designs, engineering tables, and specifications on all types of idlers. Circle No. 23.

MATERIAL LEVEL INDICATORS are discussed in a new bulletin by the Fuller Company. Two types are described which, it is said, accurately and automatically control the level of pulverized, fine, crushed or granular material in bins or silos. Circle No. 46.

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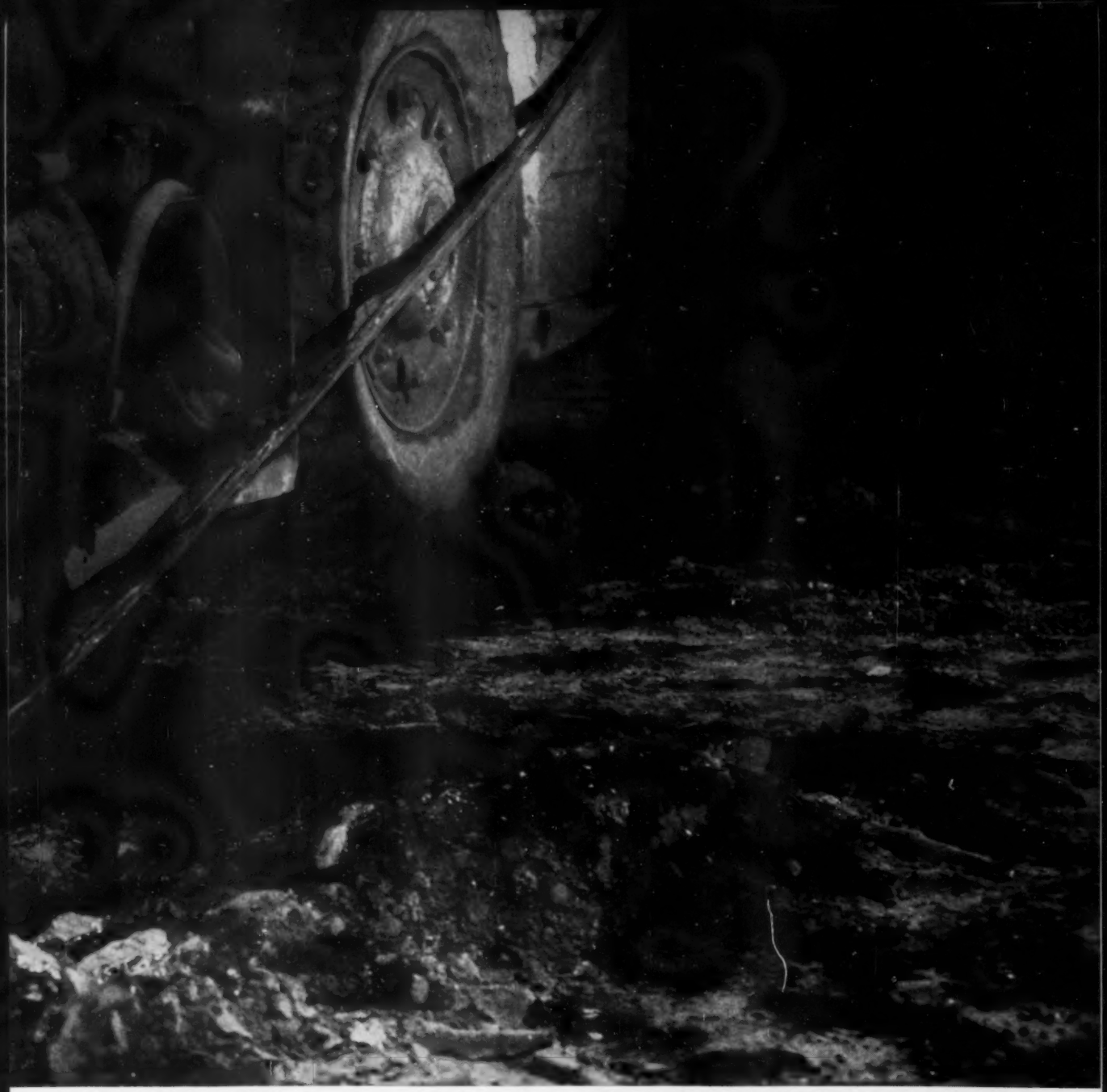

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HERMAN HARTJENS

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JEAN-PIERRE POLAR

Vincent D. Perry has been elected to the board of directors of Greene Cananea Copper Company, the Sonora, Mexico subsidiary of the Anaconda Company. Mr. Perry, who has been associated with Anaconda's mining and geological activities since 1922, and has been vice president and chief geologist of the Anaconda Company since 1957, succeeds **Russel B. Caples**, who has retired.

Herman Hartjens has been appointed technical representative for South America for Cyanamid International's mining chemicals department. Mr. Hartjens, a metallurgical engineer with 20 years experience in the mining and mineral dressing industries in South America, South Africa, and the United States, will make his headquarters in Lima, Peru. He will be assisted by **Thomas E. Rojas** of Cyanamid's Lima office.

Ik Shim Kim, mining engineer from Seoul, Korea, has completed a study of the Old Dick mine of the Cyprus Mines Corporation at Bagdad, Arizona, as part of a six-month tour of small mine operations in the western United States. The tour is sponsored jointly by the two countries as a part of a program to share information. Mr. Kim is acting chief of the mine production section of the Korean Bureau of Mines.

J. A. Pike is the new manager of Dawn Mining Company, which operates a uranium processing plant at Ford, Washington, and open-pit mines in the Spokane Indian Reservation. He had been in charge of the Newmont Mining Corporation of Canada, Ltd., Vancouver, B. C., for the last ten years, and formerly managed Island Mountain Mines Company, Ltd. at Wells, B. C.

The new board of directors of Can-Erin Mines, Ltd., Toronto, Ontario, Canada, has been announced as follows: president, **M. C. van der Voort,** Toronto; vice presidents, **William M. Lipsett,** Toronto, and **S. McCormick** of Dublin, Ireland; directors, **Joseph McParland,** Newry, Northern Ireland, **Albert G. Andrews,** Cornwall, **John A. Kennedy,** North Bay, and **Monroe Abbey** of Montreal, Quebec.

Sir John Wrightson Bt., chairman of Head Wrightson & Co, Ltd., London, England, traveled recently to South Africa. During his tour of the Union, he visited the Company's works in Johannesburg, stopping in the Orange Free State, Vereeinging Park, Pretoria, Salisbury and Bulawayo before returning to England.

James L. Oberg has been appointed a vice president of Metal & Thermit Corporation, New York, New York. Mr. Oberg also is a vice president of International Titanium Corporation, and supervises its operations and those of its wholly-owned subsidiary, Metal Recoveries Proprietary Ltd. in Australia. He will continue in his present assignment as general manager of the Metals and Minerals Division of M & T.

Lockwood W. Ferris, University of Utah and Grenoble (France) University graduate, former president and general manager of Bonneville Ltd., Wendover, and consultant to Israel and South American governments is one of several prominent mining and metallurgical consultants who have formed an independent consulting association in Utah, with headquarters at 520 E. 4th South, Salt Lake City. Others in the association well-known abroad, are: **Robert R. Porter,** formerly with Anglo American Corporation in South Africa and developer of flow sheet for Rio Tinto Mining Company's Blind River uranium mill in Canada; **Jack O. Horton,** petroleum geologist, 10 year veteran of oil exploration for Socony-Mobil in Venezuela; and **Hoitt H. Ellerbeck,** non-metallics expert, currently operating a manganese mine and mill in Chihuachua, Mexico.

Recent visitors at the Carlsbad, New Mexico potash operations of International Minerals & Chemical Corporation were three top technical men of Societa Edison Settore Chimico of Milan, Italy, in the United States to study methods for mining, minerals engineering and chemical plant design. **Dr. Renato Battain,** vice president of engineering, Inorganic Chemicals Division, **Dr. Bruno Improta,** manager of engineering of phosphoric acid, complex fertilizers and potash chemical plants, and **Dr. S. L. Pascarelli,** assistant to the manager, of Societa Edison were accompanied at IMC by **James A. Barr, Jr.,** managing engineer of Barr & Associates, Washington, D. C., consultant to Societa Edison on their potash project to develop processes for Edison's extensive Kainite potash ores.

Howland Bancroft, active in geological and mining work since 1907, has retired from the board of directors of Cerro de Pasco Corporation. A director of the Corporation since 1950, Mr. Bancroft began his career as a consulting engineer to the United States Bureau of Mines and has spent much of his professional career with various oil and metals companies in Latin America, Europe and Africa.

Jean-Pierre Polar has been appointed assistant to the director of technical information for Climax Molybdenum Company in preparation for later service with the company's Zurich, Switzerland operation. Initially, Mr. Polar's duties will be primarily in the field of corrosion and heat-resistant materials. Mr. Polar received his B. S. degree in chemical engineering from the Federal Institute of Technology in Zurich with special studies in metallurgy.

John M. Moore, Jr. has been selected for the Queen Elizabeth II Fellowship for original research in earth sciences. Mr. Moore will carry out his research project, designed to provide more information on the extent to which chemical equilibrium criteria can be applied to metamorphic rocks, at Carleton University in Ottawa. The two-year post-doctoral Fellowship was established by the International Nickel company, Ontario, Canada.

Bengt Rudling, assistant superintendent of lead smelting operations for Bolidens Mining Company, Skellefteham, Sweden, is inspecting mining and smelting operations of the Bunker Hill Company, Kellogg, Idaho under a Swedish-American foundation fellowship.

Shiro Yamagata, managing director, has been appointed president of Mitsubishi Metal Mining Co., Ltd. to succeed **Seiichi Komura,** who died on March 9. Mr. Yamagata, a metallurgist, was formerly manager of the company's Naoshima copper smelter.

Wolfgang Kotter, graduate mining engineer from Hanover, West Germany, is on a two-months' tour of the United States studying mining methods and mechanization. He has visited the potash mining district at Carlsbad, New Mexico, the uranium mines at Grants, New Mexico, the molybdenum mine of the American Metal Climax Company at Climax, Colorado, and the Baker mine of St. Joseph Lead Company, in Missouri. He also visited the Birmingham, Alabama iron mining district before returning to Germany, where he will be employed by the Buggingen Potash Company, Buggingen, Germany.

Dr. Duncan Ramsey Derry, vice president in charge of exploration of Rio Tinto Mining Company of Canada, has been elected president of the Society of Economic Geologists. Dr. Derry replaced **Dr. J. L. Gilson** of E. I. Dupont de Nemours and Company, as president of this international organization.

MEN who make the news in the U. S. A.

PAUL DASHINE

RAY L. SCHULTZE

J. P. O'KEEFE

JOE V. KERN

JAMES BOYD

Paul Dashine has been elected president and general manager of Calumet and Uranium Divisions of Calumet & Hecla, Inc. Mr. Dashine joined C & H in 1954 as industrial engineering manager of the Calumet Division. Since 1956, he has been director of engineering.

Augustin L. Queneau, metallurgical consultant and retired technical assistant to the president of U. S. Steel Corporation, has been named the 1960 recipient of the Egleston Medal, Columbia University's highest award for "distinguished engineering achievement". The award was given in recognition of his contributions to design and development of processes for the recovery of non-ferrous and rare metals.

Robert W. Geehan has been named regional director of Region III of the Bureau of Mines, Department of the Interior, with headquarters in Denver, Colorado. Mr. Geehan began his services with the Bureau of Mines in 1942; became assistant chief of Ferrous Metals and Alloys Branch in Washington, D. C., in 1951, assistant chief of the Division of Minerals in 1954, chief of the Division of Minerals Technology in the Bureau's Region IV at Rolla, Missouri in 1956, and chief of the Office of Mineral Resources for Region III in Denver in 1959. Region III includes Arizona, Colorado, Nebraska, New Mexico, North Dakota, South Dakota, Utah, and Wyoming.

John F. Janousek has been promoted to the position of general foreman of the pelletizing department at the Silver Bay, Minnesota, division of Reserve Mining Company. **Raymond P. Beving** has become a shift foreman in that department.

R. J. Council has been appointed general industrial geologist by the Atlantic Coast Line Railroad Company. Formerly industrial geologist with the company, Mr. Council has an extensive background in geology of the southeast.

M. J. Cambon has joined the staff of the M. H. Kellogg Company of New York. Mr. Cambon is with Kellogg's ore dressing and beneficiation group. Before his recent appointment, he was chief engineer, eastern district, Western-Knapp Engineering Company.

William B. York, former division industrial engineer with Kennecott Copper Corporation, has been advanced to maintenance superintendent at the Garfield, Utah smelter, a new position at that plant. He will be succeeded by **B. Blain Bradford**, formerly division industrial engineer at Nevada Mines Division.

Ray L. Schultze has resigned as general manager of the New Mexico division of Hidden Splendor Mining Company. He will join the See Tee Mining Corporation, Grants, New Mexico, as vice president and operations manager and part owner.

J. P. O'Keefe as been named general manager of the Utah Copper Division of Kennecott Copper Corporation, to succeed **F. C. Green**, who has been appointed assistant to the general manager, Western Mining Divisions. Mr. O'Keefe joined Kennecott in 1949 at the company's Chino Mines Division in New Mexico, prior to which he served as assistant treasurer of the Braden Copper Company, Kennecott's subsidiary in Chile.

Glenn E. Allen has been named superintendent of the Jamestown, Colorado mines of Allied Chemical Company. Mr. Allen has been with the firm for 13 years, and had been a mining engineering and shift boss for the property.

Dr. James E. Lawver has been appointed manager of mineral processing research for International Minerals & Chemicals Corporation. Dr. Lawver, a research staff member with IMCC since 1945, will direct minerals beneficiation research planning, as well as related laboratory and pilot plant programs at the company's Mulberry, Florida experiment station.

Edward Day Dickerman has been appointed senior metallurgist for the Western Division of Vanadium Corporation of America. Mr. Dickerman was previously associated with the National Lead Company, Monticello, Utah, as technical supervisor in uranium concentration. He earlier held positions with Cerro de Pasco Corporation, and Minerals Engineering Company, Grand Junction, Colorado.

Woods Hinrichs has been named manager of the newly-formed Exploration Services department at Fairchild Aerial Surveys, Inc. He will be assisted by **William Kellogg**, who will be chief geophysicist for the department. Mr. Hinrichs joined Fairchild in 1948 as sales engineer for geophysical sales, prior to which he was a field geologist with the United States Geological Survey.

Charles D. Carnes has been appointed plant engineering manager for the phosphate minerals and chemicals operation of International Minerals & Chemical Corporation. In this position he succeeds **J. G. La Vergne**, who has been placed on an extended special assignment.

Joe V. Kern has been named assistant to the resident manager of the United States Borax & Chemical Corporation's potash mines and refinery at Carlsbad, New Mexico. Mr. Kern, who formerly served as field accountant, joined the Company in 1951 as a clerk in the mine office.

James Boyd, vice president of exploration, Kennecott Copper Corporation, has been elected president and chief executive officer of the Copper Range Company. Mr. Boyd, who joined Kennecott in 1951 as exploration manager, was formerly Dean of Faculty, Colorado School of Mines, and Director of the U. S. Bureau of Mines.

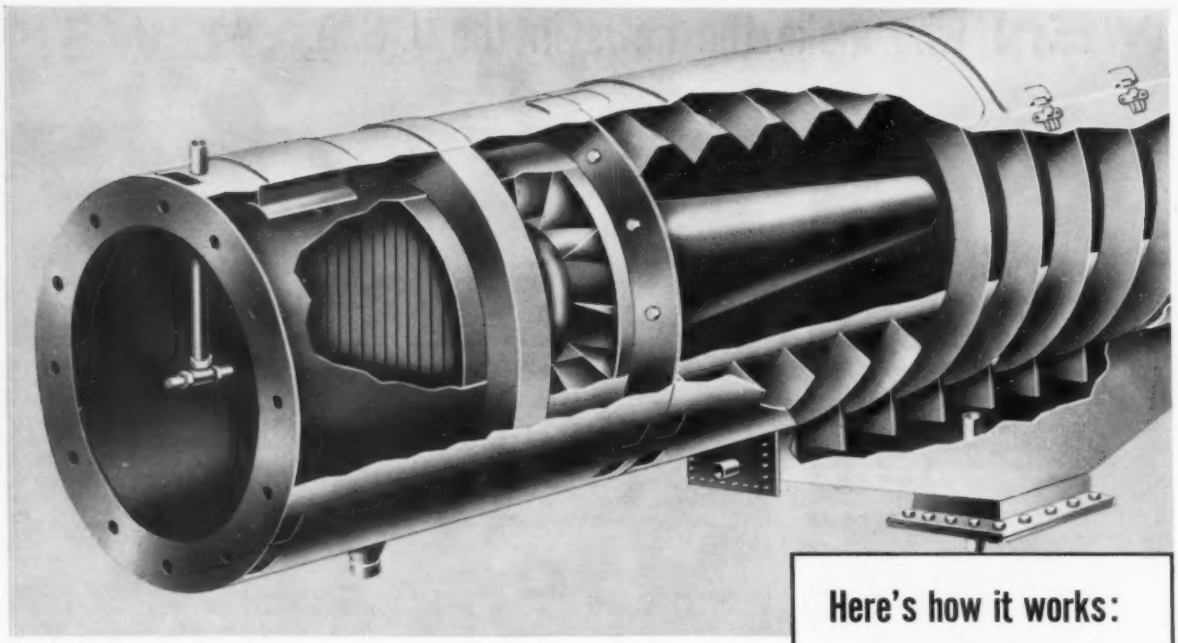
F. Robert Elsner has been appointed to the sales department of Mine and Smelter Supply Company, Denver, Colorado. Prior to joining Mine and Smelter, Mr. Elsner, a metallurgical engineer, worked as a research engineer with Battelle Memorial Institute, as sales engineer for Jeffrey Manufacturing Company, and was a district representative for Western Machinery Company.

Robert W. Braund has been appointed to the newly-created position of Manager of Mines—Minnesota and Michigan Ore Divisions for Jones & Laughlin Steel Corporation. In his new position, Mr. Braund, who was formerly manager of J & L's Michigan Ore Division, will have headquarters at Negaunee, Michigan.

Harvey B. Jordan has been named executive vice president and chairman of the general administration committee of United States Steel Corporation, San Francisco, California. Mr. Jordan, whose career in the steel industry started forty-five years ago, has most recently been executive vice president-production for U. S. Steel, and will be succeeded in that position by **Edwin H. Gott.**

William T. Maidens, general superintendent of American Zinc Oxide Company's Columbus, Ohio plant, has been promoted to the position of technical consultant. Mr. Maidens, a graduate chemical engineer of Ohio State University, has served in various capacities at the plant since it was started in 1920, and has served as general superintendent since 1942.

Henry H. Black has been promoted to the position of plant manager of American Zinc Oxide Company at Columbus, Ohio. He joined the Columbus organization in 1923 as an engineer and was promoted to the position of assistant general superintendent in 1947.



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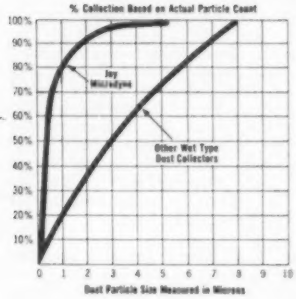

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WHAT'S GOING ON IN MINING

Reserve Mining Will Increase Taconite Capacity 60 Percent

Expansion of its taconite production facilities by some 60 percent is proposed by Reserve Mining Company of Silver Bay, Minnesota, jointly owned by Republic Steel and Armco Steel corporations. The expansion, expected to cost about $100,000,000, will be undertaken as soon as possible, Reserve officials indicated.

Preliminary engineering work has begun for construction of the new facilities, scheduled to be in operation in about two years. Reserve first opened its taconite plant, which employs 2,100 persons and cost $190,000,000, in 1955.

Reserve mined 13,150,000 gross tons of taconite ore in 1958 and shipped 5,082,784 tons of pellets. The 1959 tonnages were 10,200,000 and 3,603,602 respectively. Maximum plant output is about 5,500,000 annual tons, so a 60 percent expansion will bring capacity to 9,175,000 tons. At this expanded capacity annual ore production of the Peter Mitchell mine will be about 24,800,000 tons or 68,000 tons per day, which will make it slightly larger than Erie Mining Company, also a Minnesota taconite producer.

While Erie ore tonnages have not been released, it was the second largest open pit mine in the United States during 1959, being surpassed only by Kennecott Copper Corporation's Utah Division.

American Smelting and Refining Opens Missouri Field Office

A field office at Ironton, Missouri, has been established by the American Smelting and Refining Company as a base for exploration activities in southeastern Missouri. Several geologists, engineers, and office staff members have been assigned to Ironton, where operations are under direction of Deane F. Kent, exploration supervisor. Mr. Kent was formerly with the United States Geological Survey and an employee of ASARCO in Tennessee.

Geological mapping and geophysical studies, leading to optioning for intensive drilling, are underway through the Missouri office, which is part of the company's Eastern United States Division at Knoxville, Tennessee. Although no mining investigation is reportedly being made in Iron County, the new division's headquarters are centrally located because of adjacent counties—Washington, St. Francois, Madison, Wayne and Reynolds—which are being mapped.

Reduction Roasting Plants May Open New Reserves on Mesabi

Large reserves of presently useless nonmagnetic semi-taconite on the western Mesabi Range may become commercial if experiments at two pilot plants being built this summer are as successful as anticipated. Both plants will test technical and economical possibilities of producing iron ore concentrates from semi-taconite.

The plant that Oliver Iron Mining Division of United States Steel Corporation plans to have in operation by July 1 will use a 50-foot kiln for reduction roasting of iron ore from hematite and limonite to magnetite. Reduction is accomplished in the air-tight kiln, using reduction gases to be manufactured from petroleum gas, at temperatures ranging from 950 to 1,225° F. After reduction, the ore is ground for liberation and the magnetic iron is concentrated by magnetic separation. Agglomeration of the finished concentrate is the final step.

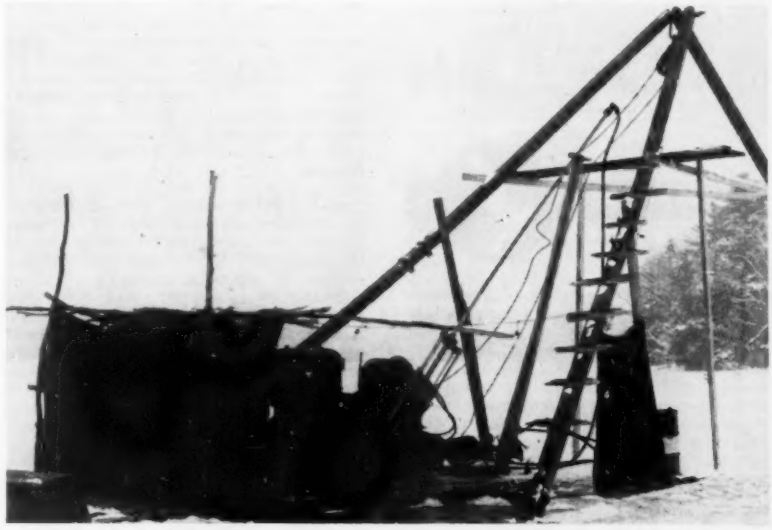
The reduction roasting process to be employed by the M. A. Hanna Company at its test plant near Cooley, Minnesota, entails reduction of the ore in a reducing medium rotary kiln, followed by grinding and recovery by wet magnetic separation. Reducing gases will be made from coal. Final concentrate will be agglomerated before steel making tests are undertaken. Completion of the pilot plant is scheduled for this fall, and drilling is now under way to verify semi-taconite deposits.

Enactment of encouraging tax legislation on semi-taconite by the Minnesota legisalture along with successful laboratory research, influenced the companies to build test facilities for the semi-taconite, which does not respond to present beneficiation methods.

The old **Empire** mine near Elizabethtown, Illinois, was flooded recently with water flowing in at the rate of 1,000 gallons per minute. Dewatering was begun immediately to save the mining equipment which was completely covered. According to B. Burgess, operator of the **Egyptian Mining Company,** water came within 135 feet of the surface of the 500-foot deep mine before some gain was made in pumping.

Reynolds Metals Company's output of bauxite in 1959 reached the highest level in the company's history, with production from its Arkansas operation representing more than half of the total United States production. The **Wightman** mine, deepest underground bauxite mine in the country, was put into production, utilizing continuous mining equipment similar to that used in modern coal operations. New reserves in the United States and abroad added several times as much ore as the amount mined, which totaled over 3,000,000 tons in 1959. Reynolds recently purchased additional bauxite producing property in Pulaski County, near Little Rock, Arkansas, from the **Dulin Bauxite Company.**

Future plans of **St. Joseph Lead Company,** when its new Viburnum, Missouri mill goes into operation, include a gradual reduction in lead production from some older mines in the Lead Belt area. The company will try to mine out available and known ore in the more remote parts where transportation and maintenance costs are high. The move will be gradual because thousands of tons of ore remain in pillars, which it would be uneconomic to abandon. The **Bonne Terre** mine, in continuous operation for 100 years, will be affected by this program, as will areas of the **Leadwood, National, Desloge,** and



Beers Drills Through Ice for Maine Nickel

Diamond drilling through ice on Crawford Pond near Union, Maine, is bringing in a wealth of data about what appears to be primary nickel deposits extending under the pond, which is over 10 acres in surface area. While ice was about 18 inches thick crews operated, despite snowstorms, 16 hours a day, six days a week. Cores go to an assay office for further analysis about the nickel-bearing pyrrhotite deposits. According to Dr. Roland F. Beers, head of the company which has been exploring the area for three years, the United States has no primary nickel deposits of commercial value now being worked. Those in Cuba, where operations have been suspended recently, are secondary deposits. The United States Geological Survey has recently released regional geologic and aeromagnetic maps covering 12,000 square miles in northern Maine.

Federal mines. Operations at the fairly new **Indian Creek** mine will probably continue at the present rate, while the new **Viburnum** operation will be expanded until full capacity of the new mill, 6,000 tons per day, is reached in two or three years.

A production goal of 240,000 tons of iron ore concentrate in 1960 is estimated by **Ozark Ore Company**, Iron Mountain, Missouri subsidiary of **M. A. Hanna Company**. Shipments in 1959 totalled about 175,000 tons of concentrate.

The feasibility of underground mining at Bourbon, Missouri, will be investigated this year by **Granite Steel City Company**, which is exploring a promising deposit of iron ore in a joint venture with the **American Zinc Lead, and Smelting Company.** Drilling at Bourbon, about 75 miles from Granite City, Illinois, indicates ore which preliminary tests could be made into high grade concentrate. It is expected that by the end of this year there will be indications of the potential tonnage available. **Meramec Mining Company** is presently sinking a mine shaft at Pea Ridge, Missouri in the same general area. In the Boss-Bixby area of southeast Missouri, also within a 75-mile radius of Granite City, test cores indicate a commercial thickness of both iron and copper ore.

A new access slope and circular ventilating shaft will be sunk by **Dravo Corporation** of Pittsburgh, Pennsylvania, at the northeastern Kansas gypsum mine of **Bestwall Gypsum Company.** The mine will serve the new plant being built by Bestwall at Blue Rapids, Kansas. The semi-circular incline, which has an 8-foot radius, is 572 feet long and terminates in a 45 by 36 by 24-foot crusher chamber. The circular shaft, which has a 7-foot diameter, will intersect the mine at a point 95 feet underground. Steel liner plates, with concrete grout behind them, will reinforce the slope walls.

EASTERN STATES

American Zinc Company of Tennessee has scheduled a May start for shaft sinking at its new **Immel** zinc mine near Strawberry Plains, Tennessee. The circular shaft will be at least 1,000 feet deep. A long drift will probably connect the new mine with the **Mascot** mine to the west. At the Strawberry Plains DMEA area, the company has proved and indicated an area that will produce approximately 1,000,000 tons of 60 percent zinc concentrates. Total amount of drilling by the end of 1959 was 177,119 feet. A new all-time record for its Tennessee operations—64,013 tons of zinc concentrates—was set by the company last year. At its **Young** mine a new upper-run of ore was indicated and recent drilling has been encouraging. In the Tennessee district the company has reasonably well proven and indicated 85,000,000 tons of ore from which is expected a minimum of 5,000,000 tons of 60 percent zinc concentrates.

The McCall Cotton Company of Easley, South Carolina, has reportedly leased the Wilkins Creek pyrrhotite prospect near Waynesville, North Carolina, believed similar to the Ducktown, Tennessee, copper deposits.

The production rate of the **Fridensville,** Pennsylvania mine of **The New Jersey Zinc Company** continued to increase, although progress toward optimum production is slower than anticipated. Development of the lower levels has continued and the main haulage line has been connected to the 600-foot level. Stoping is now underway on the 800-foot level. The company's **Austinville** and **Ivanhoe,** Virginia mines, which were shutdown for some time in 1958-1959, are now supplying the Austinville concentrating mill, which is almost to full capacity once again. In Tennessee, the **Jefferson City** mine increased production in 1959 so that the concentrator was operated at full capacity, and the company began production of its new **Flat Gap** mine at Treadway. Mine production there is expected to match mill capacity in 1960, now that production rates have increased and stope preparation sufficiently advanced. New Jersey Zinc's **Sterling** mine in Ogdensburg, New Jersey, remains on a stand-by basis, but studies for more efficient extractive methods continue.

Reopening of the **Hamme** tungsten mine near Henderson, North Carolina was scheduled in April by **Howe Sound Company** joint owner (70 percent) with **General Electric Company.** Closed since 1958 because of low price and demand, the mine produced 165,393 units of concentrate in fiscal 1956, its top production year. Ore reserves that year amounted to 1,453,000 tons, an all-time high.

The **Dow Chemical Company** of Midland, Michigan, has dropped its three-year option on a 400-acre tract in Maine which contained a lithium bearing pegmatite deposit. An extensive mapping and drilling program was undertaken by Dow while it held its option on the state-owned tract. The lithium claim area in Warren Township, Knox County, Maine, is part of a tract of state institutional land administered by the Maine Mining Bureau.

A Columbium Metallurgy Symposium is scheduled June 9 and 10 at Lake George, New York, under sponsorship of the Hudson-Mohawk Section of **AIME.**

Tennessee Products and Chemical Corporation recently re-started the No. 2 blast furnace for pig iron at its Rockwood, Tennessee plant, but continued operation depends on the market situation. Iron ore for the furnace is mined at a newly discovered deposit in Union County, Tennessee.

Producers and fabricators of zirconium have organized **The Zirconium Association,** with offices at 2130 Keith Building, Cleveland 15, Ohio. The new group will promote non-government markets for zirconium and has issued a fact file containing technical data, applications, and available forms of the metal, which has many uses in diverse industries.

Foote Mineral Company of Philadelphia, Pennsylvania, is purchasing a 670-acre plant site in the New Johnsonville, Tennessee, area for construction of its third electrolytic manganese facility. Foote now operates two plants of this kind in Knoxville, Tennessee and also has extensive research facilities.

Hematite ore averaging 52 percent Fe is being mined at a new mine in Union County, 50 miles from Rockwood, Tennessee. The ore is being produced from the Clinton sedimentary iron-ore beds of Silurian age, similar to the source of ore in the Birmingham, Alabama district. After the iron is stripped, it is loaded into trucks and hauled to Rockwood for processing at the No. 2 blast furnace of the **Tennessee Products and Chemical Corporation,** producer of pig-iron and ferro-silicon for consumers in the Southeast.

IRON RANGES

This year's ore shipping season was opened by **Inland Steel Company** whose ore boat reached Chicago in late March with the first load of Upper Lake iron ore for the year. **United States Steel's Pittsburgh Division** began the season the first week in April, loading seven ships at Two Harbors, Minnesota. Limestone shipping was also resumed by **United States Steel's Michigan Limestone Division.**

Major domestic expansion for **The Cleveland-Cliffs Iron Company** is accelerated development of its Michigan jasper properties. At the pelletizing plant of **Marquette Iron Mining Company,** in which CCI owns a 53.76 percent stock interest, an annual production rate of over 650,000 tons has been reached. The 800,000-ton expansion will yield a higher iron and lower silica product through an improved concentration process. An improved pelletizing process will also be used. The pilot plant, completed in 1959, has been valuable in achieving further developments in concentrating and pelletizing both magnetic and non-magnetic jasper ore. Cleveland-Cliffs expects its expanded **Humbolt** mine project to be in operation by midyear, while at its **Republic** mine, improvements are aimed at increasing annual output from 650,000 to 1,450,000 tons. When the concentrator and pelletizing section at Humboldt are completed, the mine will be able to produce 2,000 long tons of concentrate and pellets daily. K. C. Olson is mine superintendent and R. W. Berkhahn operating metallurgist at this plant.

The Minnesota Ore Division of Jones and Laughlin Steel Corporation has placed its Lind-Greenway concentrator in operation. Washing facilities will beneficiate wash ores from the property. Current plans include the addition of gravity separation processes to the plant within the next year.

The decision of the **M. A. Hanna Company** to build a new semi-taconite test plant in the Nashawauk-Cooley, Minnesota, area was influenced by the tax law passed in the last session of the Minnesota state legislature. The law provides for a basic tax of five cents a ton on the finished agglomerate product made from semi-taconite, and a tax of ten cents a ton on that portion not agglomerated in the state. The tax is subject to graduated increases on the product's iron content and is in lieu of property taxes on the processing facilities and the semi-taconite deposits. The assessment is in addition to occupation and royalty taxes on ore.

COLORADO

Standard Metals Corporation, until recently Standard Uranium, will start work soon on the Terry level of the **Sunnyside** mine near Silverton, Colorado taking equipment to the mine above Eureka where track will be changed from 18 to 24-inch gauge. The company hopes to have all necessary work completed on the Terry level to coincide with holing through of the raise from the American tunnel next winter. Since the raise to connect the American Tunnel with the Sunnyside mine will not be large enough to handle equipment needed for the Terry level, it must be taken in while the tunnel is accessible by truck via Eureka Gulch. The American tunnel is now in solid ground heading toward the Washington shaft of the Sunnyside mine. Early in April the bore was in 5,631 feet. At that time, too, the Unity raise in the **Silver Lake** mine was holed through from Shennandoah workings giving access to a part of that mine that has not been worked for 50 years and also improving ventilation. The raise was driven in record time and will be timbered and equipped with a man skip with one compartment used as an ore pass. Mining in this part of the Silver Lake is expected to start soon. Excellent progress is also reported in construction of the company's sampling plant, with walls and roof erected early in April, and pouring of concrete to follow. Indications are that ore shipments will be started this fall.

Development footage in 1959 for **Idarado Mining Company** in its Ouray, Colorado mine amounted to 2,048 feet, about 1,000 less than in 1958, in the Black Bear section. Heavy underground water flow along the vein structure on the 2,000 level limited drift advance to 445 feet southeasterly. Development of the 1,600 intermediate level midway between 1,200 and 2,000 levels is under way from the 2,011 raise. A new ore reserve was developed in the northwest portion of the vein by the 320 raise. In the Montana-Argentine section total footage was 6,328 feet, compared with 5,967 feet in 1958. The main 2,400 level drift southeast of 2,930 shaft in the Telluride conglomerate was advanced 2,167 feet. It exposed continuous ore, as did the 300 level drift northwest of the Argentine-Black Bear vein intersection. A high ore payability was disclosed by progress on 2,100 level southeasterly through the 34 to 31 blocks. Exploration diamond drilling during the year was only 5,648 feet because drilling sites are not presently available from existing workings.

Although the uranium-vanadium mill of **Vanadium Corporation of America** at Durango, Colorado, operated at a loss during 1959, results were improved somewhat over those of the last half of 1958. The company expects further improvement with more satisfactory returns in 1960, despite reduced prices paid for uranium concentrates. Difficulties resulting from effluent disposal at the mill are being overcome, exploration is being increased, and additional properties are being leased by the company.

At the **Gilman,** Colorado mine of **New Jersey Zinc Company,** production of copper-silver ore was curtailed during the last half of 1959 because it was necessary to find new, economical smelting outlets for the ore. Production of lead-zinc ore continued at Gilman.

Over $45,000,000 was spent by **Union Carbide Nuclear Company** in 1959 for its uranium-vanadium mining and milling activities, including exploration and mine development, plant expansions, and operating expenses of mills. Construction of a new uranium mill in the Wyoming Gas Hills region was a major capital expenditure. The recently-completed mill, located about 78 miles west of Casper, has a rated capacity for processing 492 tons of uranium ore daily. Operated by Globe Mining Company, a unit of Union Carbide Corporation, its activities are being coordinated with other UCN operations in Grand Junction, Colorado. Expansion of mining operations in 1959 included work at the **Dermmo** mine near Dove Creek where over 100 new workers were employed. In all, 800 miners both on a contract basis and as UCN employees, mined nearly 1,000,000 tons of ore which was hauled to the company's mills at Rifle, Uravan, and Maybell. UCN's 931 employees in the Colorado Plateau area received approximately $5,000,000 in salaries last year.

The **Alta-St. Louis** mine near Telluride, Colorado has been purchased by **Silver Mountain Mining Company** of Peoria, Illinois from Mrs. Grace Wagner of Montrose, Colorado. According to Donald J. Risser, head of the Silver Mountain firm, it will take immediate possession of the property which includes 47 patented and 49 unpatented mining claims. After rehabilitation of the property, a 100-ton mill will be built replacing that destroyed by fire in 1948 when the mine operation became inactive. Basically a gold-silver property, with lesser values in lead and copper, the Alta-St. Louis has a history dating to 1877. The mine was last sold in 1937 for $1,000,000.

Plans for erection of a mill at the Richardson lode in the Red Mountain district, Colorado, have been announced by Frank Richardson, president of **Richardson Mines.** By the time the mill is in operation an adequate supply of ore from the **Brooklyn** mine should be available for processing. Several bodies of ore have been opened up on the gold-silver, lead, and zinc mine. During the winter a six-man crew has done considerable development work, using snowshoes for infrequent trips from the mine to town. The Richardson holdings in this area comprise 76 patented and unpatented claims.

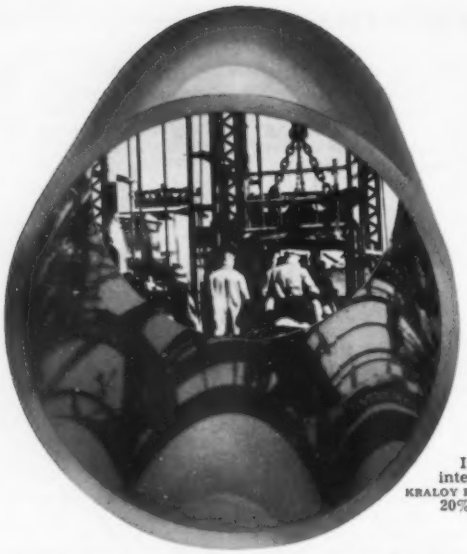
UTAH

Construction work on a major phosphate rock crushing and beneficiation plant began in April at a site near Vernal, Utah, where **San Francisco Chemical Company** will eventually have a six-unit plant with a total capacity of over 1,000,000 tons of concentrates per year. Unit No. 1 of the installation, to be known as the Harry Ratliff Concentrating Plant, will consist of a 250-ton per hour crushing plant, followed by a grinding, blunging, de-sliming, flotation, filtration and drying plant with a capacity of over 200,000 tons of phosphoric concentrate annually. Designed by **Western Knapp Engineering Company,** the initial unit is scheduled for completion by November. Concentrate will be trucked 200 miles to Western Phosphates Inc., at Garfield, Utah to be used as raw material for production of wet process phosphoric acid, ammonium phosphates, and treble superphosphate. San Francisco Chemical will do its own stripping, mining, and hauling of phosphate to the plant, with mining on a two-shift, five day week, basis the year round. Last year San Francisco Chemical purchased a 15,000-acre phosphate deposit 15 miles north of Vernal that it formerly leased from **Humphreys Phosphate Company.** Future plans in connection with the big project indicate construction of a high analysis phosphate fertilizer plant in the Vernal area, either by Western Phosphates or by **Stauffer Chemical Company,** which owns 50 percent of both Western Phosphates and San Francisco Chemical.

Uranium Reduction Company, according to its AEC contracts running until the end of 1966, plans to recover 10,677,767 pounds of uranium from Hidden Splendor ores; 2,990,517 from **Homestake Mining Company's LaSal Mining & Development Company** properties; 6,002,708 from **Hecla Mining Company-Radorock Resources Inc.**; and 3,772,123 pounds from the **MiVida** mine of **Utex Exploration Company.** In addition it will recover 364,800 pounds from joint venture claims it now owns and 732,748 pounds from other properties the AEC will designate. Last year the firm invested $1,800,000 in improvements at its Moab, Utah mill, completed in 1957 and originally costing $8,626,000. In the seven months ending last January 31, the firm produced and sold 1,746,847 pounds of uranium concentrates.

A considerable increase in ore values and a 23 percent increase in reserves last year are reported by **New Park Mining Company** of Keetley, Utah, which is undertaking an $800,000 exploration program in Utah's Park City district. The ore is found in replacement beds of the Deseret limestone formation on the 1,880-foot level, where work is both below ore and above ore. It is believed that the replacement beds extend downward to the present 2,005-foot exploration level where the DMEA-aided exploration program is going on. This project is important because it gives the firm opportunity to intersect extensions of ore from the 1,880-foot level, has the opportunity of developing new ore zones, and it is to be the first such exploration program in the district that will have tested stratigraphic horizons in and below the Deseret limestone.

Goals set by Utah Copper Division of **Kennecott Copper Corporation** for 1960 call for mining and benefication of an average of 90,000 tons of ore per day, a stripping ratio of 1.74; smelter production equal to mills' output and refinery production of 168,000 tons of refined shapes. Last year the $16,000,000 addition to the division's power plant was virtually completed, an expansion that increased electrical output to 175,000



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kilowatts. Another 1959 project was the 18,000-foot haulage tunnel for mining ore from the lower levels of the mine without hauling it considerable distances up grade. Modernization of the Garfield smelter acquired last year from **American Smelting and Refining Company** is expected to entail a $10,000,000 expenditure in 1960. Exploration at East Tintic, Utah, resulted in discovery of an ore body of moderate tonnage containing lead, zinc, silver, and some gold. A decision on production there has not yet been announced.

The old **Creole** mine which overlooks the community of Minersville in Beaver County, Utah, shows promise of a revival of non-ferrous metal mining. The old mine operated profitably from the early 1900's to shortly after World War I. Because it was regarded primarily as a copper prospect, it was closed at that time and not revived for lead-zinc mining in the 1920's. **Heinecke Brothers,** Moab, Utah, contract miners, later became interested because of a reported major iron deposit in the Lincoln Mining district near Mineral Mountain. The firm acqured operating rights and examined the old workings only to find that the deposit's size did not warrant development. However, considerable mineralization in copper, gold, silver, zinc, and bismuth was evident. Last spring a mill was completed with a potential of about 120 tons a day. The firm has delayed shipping operations because of the strike situation, but has now stockpiled 500 to 1,000 tons of ore at the mine. It is estimated that there are between 30,000 and 70,000 tons of ore ready for development, disclosed as a result of previous copper mining. The ore is apparently a limestone replacement or along a contact between the limestone and granite.

WYOMING

Underground operations have been started by John D. Cummings at the **Little Mo Uranium** mine at Copper Mountain, Wyoming, about one-half mile south of previous operations. Daily production has averaged about 50 tons with the ore assaying 0.23 percent U_3O_8. Exploration drilling has revealed a similar deposit one mile to the north on the Clifford Reed property where a large scale development program is being started.

The **Atomic Energy Commission** has awarded a contract for development of methods for accurate measurement of minute quantities of radioactive materials in drinking water or air that may be taken into bodies of people working in uranium mines, mills, refinery, or fuel processing plants. **Ionics, Inc.** has set up a special radiochemical analysis laboratory in its Cambridge, Massachusetts, plant to carry on this work and will also use outside services and laboratories. The $103,000 contracts calls for determination of very small amounts of radium and thorium isotopes in solutions and solid residues. Analytical techniques will also be applied to human wastes where radioactive elements will collect and can often be related to the radiation dose received by individual workers.

Jefferson Asbestos Mill Slated For Operation Early Next Year

The $5,000,000 California asbestos mill to be built by Jefferson Mining Corporation is expected to be in operation early in 1961, with present plans aimed toward a daily output of 2,000 tons of ore mined and processed. The company is negotiating for acreage contiguous to its major chrysotile asbestos deposit, near Copperopolis in Calavaras County, that will provide a mill site plus ample area for disposal of tailing.

Before acquiring the property late last year, Jefferson Mining, a Nevada subsidiary of Jefferson Lake Sulphur Company of New Orleans, Louisiana, performed 25,000 feet of diamond drilling, core logging, and pilot plant milling, which has proven 15,000,000 tons, of chrysotile asbestos ore of excellent grade and quality, minable by the open pit method.

A probable ore reserve of about 5,000,000 tons is indicated at depth continuation of the proven ore zones available for economical open pit mining. Several million tons of "possible ore" may be discovered below the "probable ore" horizon, and, if developed, could be mined by underground block caving.

Jefferson acquired the property from the American Asbestos Mining Corporation of New York. Tellepsen Petro-Chemo Constructors of Houston, Texas has the preliminary mill design contract.

U_3O_8 Mine Trades Claim Rights For Ore in Park

Legislation has been introduced in Congress which eventually would give the National Park Service title to the last island of privately owned land within the Grand Canyon National Park—the 20-acre Orphan mining claim located 1½ miles west of Grand Canyon Village and operated by Western Gold and Uranium, Inc.

The Orphan claim was patented on March 23, 1906, by D. L. Hogan and C. J. Babbitt—two years before the area was claimed as a national monument by President Theodore Roosevelt, and 13 years before the area was raised to park status by congressional act in 1919. Hogan located the claim as a copper prospect, but the green mineralization he found was secondary uranium. The correct identification was made shortly after World War II, by a United States Geological Survey crew making a routine check of the claim.

Under an agreement worked out between the government and the mining company, title to the land would pass to the government within six months, but mining rights are to be retained by the mining company for 35 years. The tourist accommodations—the Grand Canyon Inn—would be permitted to continue to operate through the 1966 season, after which only approximately two acres—the area needed for actual mining operations—are to be used by the mining company. The land would be acquired by the National Park Service without cost in return for permitting the mining of ore under park land adjacent to the mining claim. Royalties from ore produced will go to the National Park Trust Fund Board.

ARIZONA

The Banner Mining Company, A. B. Bowman, vice-president and general manager, has purchased the **San Xavier** mine near Sahuarita, Arizona, from **McFarland and Hullinger**. McFarland and Hullinger acquired both the San Xavier mine and Sahuarita mill from **Eagle-Picher Company** early in 1957 following approximately two years of leasing operations. Since then, production from the mine has been intermittent, depending upon marketing conditions and metal prices. Shortly before the shutdown at the end of October 1959, the San Xavier had been producing about 60 tons of lead-zinc ore daily.

Inspiration Consolidated Copper Company, Inspiration, Arizona, has concluded negotiations for the purchase of the Miami smelter of **International Smelting and Refining Company**. The Miami smelter, which is adjacent to Inspiration's plant, treats Inspiration concentrates and cement copper, as well as material from other producers, and will handle concentrates from the **Christmas** mine. With ownership of the smelter and completion of a major addition to its electrolytic refinery, scheduled for the end of 1960, Inspiration will be in position to ship the full copper output of its **Inspiration** and Christmas mines and a part of the smelter's toll and custom ore intake in the form of refined cathodes. The company estimates that in the development of its Christmas mine a further expenditure of about $4,375,000 will be required, while surface plant and facilities will call for an additional investment of about $8,900,000. Present plans call for completion of the Christmas Project late in 1961, at which time the property will have a capacity of 4,000 tons of ore per day. Copper production will approximate 36,000,000 pounds per year. Ore reserves are estimated at 20,061,625 tons of proved and probable ore averaging 1.83 percent copper, with a recoverable copper content of 660,000,000 pounds. Bruce B. Whitney is general superintendent at the Christmas mine.

Phelps Dodge Corporation will abandon a large group of mining claims in the Naco Hills area of Arizona which it had recently filed for record. Located between Bisbee and Naco, about 65 of the claims are Type A (lode) on state lands in T. 23 S., R. 23 E., while some 20 claims are Type B on state lands in T. 24 S., R. 23 E.

Palo Verde claims owned by **Banner Mining Company** in Arizona's Mineral Hill mining district are regarded as a major copper ore prospect, the company reports. Drilling on a small area of Banner's property, surrounded on three sides by Mission Project claims of American Smelting and Refining Company, has already proved reserves of several tens of millions of tons of low grade copper ore. Predictions are that it will take 30 years to mine the ore at the rate of 5,000 tons

Helicopters Speed Exploration on Arizona Peak

Test drilling at the Ithaca Peak exploration project of Duval Sulphur and Potash Company, resumed recently, means a tricky job of getting equipment to a particularly inaccessible spot near Chloride, Arizona. When Boyles Brothers Drilling Company began the job, the location on a perpendicular rocky ledge 1,000 feet above the nearest level spot called for one solution—helicopters. PDQ Helicopter Airways of Phoenix came to the rescue and within five hours had lifted eight tons of drilling equipment from the 3,900-foot loading level to the 4,900-foot mountain top. The load included drill rods, casing, a 600-pound wire line hoist, pumps, diamond core drills, sludge tanks, a ton of cement and two tons of gasoline—all stuffed inside or dangled below the aircraft. In the picture above, one helicopter is unloaded at a sketchy wooden landing flatform, while 1,000 feet below, the other aircraft is being loaded. At present six men are working on geological-geophysical phases of the program and supervising the drilling. Ithaca Peak is a quartz monzonite stock mineralized with pyrite and chalcopyrite, having several shear zones that show extensive copper mineralization cutting the stock.

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per day. Banner has core-drilled the ore body on 250-foot centers across its property north and south for 1,320 feet, and a distance of 1,750 feet east and west. The ASARCO Mission project involves a $43,000,000 program including an open-pit mine and establishment of a mill. Banner is carrying out its $1,000,000 Palo Verde shaft program to mine a higher grade copper ore not available for open-pit mining, with full operation scheduled for 1962.

The Ray Mines Division of **Kennecott Copper Corporation**, Hayden, Arizona, produced a total of 26,257 tons of copper in 1959, compared to 42,932 tons in 1958, stated the company's annual report. The drop in output was due to the strike which closed down all operations from early August to the end of the year. The report also noted that the expansion program at the Ray division is nearing completion. This program involving an expenditure of approximately $40,000,000 will make possible the production of 20,000 additional tons of copper annually, an increase of 40 per cent. Concerning the company's purchase last year for about $4,000,000 of some 120 mining claims aggregating about 2,000 acres in the Gila Mountains near Safford, Arizona, the report stated: "The tonnage indicated to date is sufficient to warrant plans for future mining, but the engineering and metallurgical problems are yet to be solved and development at Safford will continue for some time."

Production of high lime and silica flux ore has been resumed by the **Narragansett** mine in the Helvetia district of Pima County. The mine had been shut down from August 12, 1959, until January 25, 1960. Current production is at the rate of about three carloads (180 tons) per week. Operator of the property is **C. D. Wilson Mining, Inc.**, and Hercel Hickman, foreman.

Cyprus Mines Corporation has started sinking a new shaft at the **Copper Queen** mine, seven miles southwest of Bagdad, Arizona. Present plans call for a 500-foot shaft with drifts on the 350 and 450-foot levels. The project is expected to take approximately five months.

CALIFORNIA

The job of cleaning out and dewatering old workings of the old **Gold Canyon** mine in the Alleghany district of Sierra County, California, has been completed but inclement weather slowed down opening up of new and virgin areas. However, the operating company, **Gold Canyon Mines, Inc.**, of Stockton, reports the mine is now dry and ready to proceed with sinking the shaft and driving new drifts on the 550- and 700-foot levels.

A 1,300-foot conveyor belt system will cut costs of transporting boron ore from the bottom of a huge open-pit mine to surface plants of **United States Borax & Chemical Corporation** at Boron, California. The project, to start this spring and be completed by fall, will also provide increased flexibility in meeting future ore demands. The continuous belt operation, rising 315 feet from pit to the surface, will replace truck haulage to the company's adjacent plants. Trucks currently haul ore to the surface crusher, traveling 2½ miles. The pit is 2,000 feet long, 1,700 feet wide, and 275 feet deep.

An exploratory hole large enough to allow geologists to be lowered into the ground for direct subsurface work was drilled recently near the open-pit mine of **Pacific Coast Borax Company** near Boron, California. **Partain Exploration Company** and **O'Meara & Rogers Construction Company** cooperated in the project to permit direct study and sampling of mineral formations prior to planned expansion of the mine. First a 16-inch hole was drilled 242 feet deep and then a dry 26-inch hole was reamed out to permit entry and study.

New facilities at the Eagle Mountain, California, iron ore mine of **Kaiser Steel Corporation** under construction the last year include a 500,000-ton ore blending facility, a 3,000-ton per hour primary gyrator crusher, and a 1,500-ton per hour secondary crushing plant. Stockpiling facilities and railroad loadout and track extension are also part of the expansion. With the new equipment it is possible to load an entire train of ore with movement of railroad cars by gravity.

NEVADA

At the **United States Milling & Minerals Corporation** cyanide mill in Silver Peak, Nevada, standby equipment for sulphur dioxide leaching has been reactivated recently so the mill can handle certain special types of silver ores. Automatic devices have also been installed to increase the mill's capacity for custom milling. USM&M accounted for over 35 percent of Nevada's total silver production in 1959. Future plans of the company include addition of a cyanide regeneration system at the Silver Peak mill, which could cut milling costs about $200 a ton.

The M & M quicksilver property in the Tybo mining district of Nevada has been leased by Joe Clifford and his sons, who are carrying on active mining and milling operations there. Ore is mined from one side of a former glory hole. Ore is tabled for concentration at the Clifford Stone Cabin ranch and the concentrate put through the retort. The M & M mine, located north of Warm Springs, was last worked in 1954, before being leased to **Mercury Uranium** which held an option until recently.

Belmont Mine Company has completed work on the winze and started drifting operations on its **El Drodao South** property near Belmont, Nevada, where high-grade ore was recently discoverd in the bottom of the tunnel on the 1,000-foot level of the incline shaft. Since the mine was opened about 10 months ago, 450 feet of vertical shaft has been cleaned out and retimbered. About 1,000 feet of lateral work on the 1,000-foot level of the incline shaft has been cleaned out and put in shape. Although some timbering and lagging has been necessary, in some places the original 100-year-old timbers are still sound, despite having

been under water for the last 80 years. The crew of 12 to 15 men operates the men operates the mine on a 24-hour basis. While water has increased to about 120 gallons per minute with the additional depth of the winze, modern pumping methods are handling it adequately.

Kamco Mining Company of San Diego, California and Mina, Nevada has leased the **Reveille** mine on Pilot Mountain, 10 miles southeast of Mina. The mine is owned by O. J. Belleville of Mina, whose mill on the property burned down several years ago. Kamco is building a new mill and plans to open-pit the ore body, which reportedly assays $10 to $15 per ton.

Belmont Mines Company, which is developing the **El Dorado South** mine at Belmont, Nevada, recently purchased the Mary gold mine at Silver Peak, Nevada. Belmont plans to reopen the mine, an old gold producer operated formerly by the E. L. Cord interests and in the 1940's by **Black Mammoth Consolidated Mining Company**. The new owner will ship ore to the Silver Peak cyanide mill of United states Milling and Minerals Corporation.

A large deposit of very pure bentonite has recently been located at the north end of Fish Lake Valley, about 40 miles northwest of Tonopah, Nevada, by the **Nevada Clay Products Company** of Hawthorne, Nevada. Based on nine churn drill holes, the flat bed of bentonite averages 60 feet thick. It crops out on the surface and beneath up to 38 feet of overburden. Preliminary estimates show large reserves of bentonite with negligible sand.

The new skip hoist installation completed last year at the **Nevada Mines Division, Kennecott Copper Corporation**, Ruth, Nevada, has resulted in an operation comprising truck haulage within the Liberty Pit, augmented by skip hoisting from the lower levels, a more economical process here than haulage by rail.

NEW MEXICO

Uranium reserves of **Homestake Mining Company** in New Mexico are sufficient to last through 1966 and the company anticipates extension of Atomic Energy Commission purchase contracts to December 31 of that year. The Homestake-Sapin Partnership expects repayment of its bank loan and $9,500,000 advanced by Homestake to the partnership by 1963, with an average return of about 12 to 15 percent after taxes during the 10-year life of the venture. Homestake operates two uranium mills in the Ambrosia Lake area of New Mexico. One produces at 1,500-tons-per-day capacity, and the other at half that rate.

Production of zinc is being resumed after a three-year shutdown at the **Pewabic** and **Kearney** mines in New Mexico, owned jointly by **Hydrometals Inc.** and **American Zinc, Lead & Smelting Company**. A drilling program by the latter firm has indicated unknown and higher grade ore bodies. Hydrometals operates the mining properties and the mill at Deming, New Mexico, through its subsidiary, **Peru Mining Company**.

The mica processing mill completed last year for **Clute Corporation** at Cordova, New Mexico, will provide raw mica for a new "fine grind" plant that will use high speed air impact to grind mica to minus-400-mesh, for use in paint, glassware and building materials industries. The Clute firm, based in Denver, Colorado, plans to make the mill, only one of its type in the area, available for custom milling and grinding for other mining operations.

The Homestake-Sapin Partnership, which operates uranium mines in McKinley County and a mill at Grants, New Mexico, furnished the major part of the revenue for Sabre-Pinon Corporation during the last half of 1959. Total Sabre-Pinon earnings for the period ending December 31, 1959 were $709,373. Production from the **Black Jack** mines of **Lance Corporation,** Sabre's wholly-owned subsidiary, began in December and earned a net of $96,213, and the Trucking Division also began operating for an additional profit. The figures given cover the first six months of the company's fiscal year which ends June 30. During the previous fiscal year, Sabre-Pinion's net profit was $81,925.

TEXAS

November 1 is the expected date for starting operation of Texas' first uranium mill. **Susquehanna-Western, Inc.** has completed negotiations with the Atomic Energy Commission for construction of the processing mill near Falls City, Texas, providing for production of a total of $13,000,000 of U_3O_8 concentrate. The company has also obtained leases on several mining claims, where ore bodies have been proven. Investment in the operation is expected to approximate $2,350,000. The firm also has a 500-ton-per-day uranium mill in Riverton, Wyoming, and a custom mill in Edgemont, South Dakota.

United States Sulphur Corporation has opened its new multi-million dollar Frasch sulphur mine at High Island Dome, 38 miles east of Galveston, Texas. For a week before the official opening, the company mined at 20 percent capacity, waiting for a nine-mile natural gas pipeline to be laid. The sulphur deposit, a wildcat discovery of the company's president and owner, Harry T. McClain, is expected to have a daily output of 1,200 tons of sulphur, within the first four months of operation.

American Lithium Chemicals Inc., a subsidiary of **American Potash & Chemical Corporation,** this year will complete its five-year AEC contract to supply large quantities of lithium hydroxide. The San Antonio, Texas company is considering manufacture of other chemical products in its plant, and maintains contact with aluminum companies engaged in experimenting with use of lithium as a process material in reduction cells to make primary aluminum.

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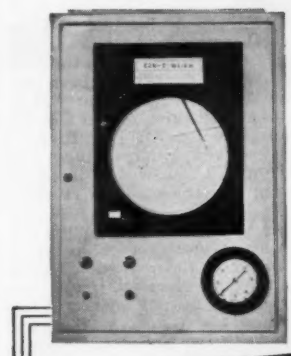

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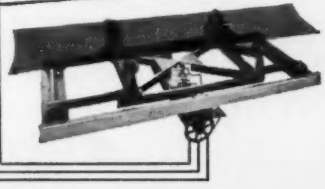

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ALASKA

United States Smelting and Refining Company plans to operate nine dredges at its Alaskan properties during the coming season. Operations have been suspended during the winter. Four will be in the Fairbanks district, one at Chicken in the Fortymile, one at Hog River in the lower Koyukuk country, others near Nome. About 250 men will be hired out of Fairbanks and about 125 at Nome.

Little Squaw Mining Company is preparing for its second year of operations in the Chandalar Lake area 200 miles north of Fairbanks. Plans call for 600 feet of drifting on gold-bearing quartz reached in a raise from the Mikado adit last season. Eskil Anderson, Spokane, Washington is engineer in charge.

Alaska will receive $1,421,535 as its share of receipts from mineral leasing activities on federal lands within its borders during the last half of 1959, according to Secretary of the Interior Seaton.

The **Drumheller** interests of Spokane, Washington, and **Alaska Mineral Consultants** of Anchorage are making plans to reopen the **Fern Gold Mining** Company's mine in the Willow Creek district. Preparation will include clearing of caved openings and replacement of the original mill. One of the better producers in the Wilow Creek group, the Fern Gold mine is on Archangel Creek near Wasilla, Alaska.

IDAHO

The Idaho-Almaden mercury plant of **Rare Metals Corporation of America** near Weiser, Idaho produced 1,736 flasks of mercury during 1959, with a gross sales value of $402,008. Mine output was 54,989 wet tons of ore averaging 3.17 pounds of mercury per ton. A total of 55,230 wet tons was furnaced for an average daily rate of 153 tons.

Holdings of the **Salmon Uranium and Idaho Thorium** companies and other properties in the Lehmi Pass area of Montana and Idaho valued at $11,000,000 have been acquired by **Nuclear Fuels and Rare Metals Corporation** of Pocatello, Idaho and Los Angeles, California, which now holds over 7,000 acres of mining claims in the area. According to D. B. Lewis, president, four years of exploration, surveying, and engineering have been completed. Nuclear Fuels recently acquired the $250,000 mill and plant which **Salmon River Uranium and Development Company** completed last year. More machinery and equipment are being added to concentrate and upgrade thorium and rare earths at the 100-ton-per-day plant that starts operation this spring under its new owners.

In a move preliminary to resuming development work at the **Commonwealth** mine on Hayden Creek near Hayden Lake, Kootenai County, Idaho, **Sunshine Metals Corporation** is offering an exchange of stock to **Nighthawk Silver Lead Mining Company** shareholders. A. C. Townsend, Spokane, is president of Sunshine Metals, and Don A. Gillis, Spokane, secretary. Bert Enger, Gig Harbor, Washington, heads Nighthawk.

A car bumper strip bearing a picture of a prospector and his mule and letters in orange fluorescent paint reading "Support Mining; Gold Is Money" has been issued by **Prospectors and Miners', Inc.**, Grangeville, Idaho. A membership car window sticker picturing a prospector and his mule against a green background of mountains also has been issued to the organization's 125 members.

Kimberly Gold Mines, Inc., is planning to start milling ore this spring at its mine 40 miles east of Riggins, Idaho County, Idaho. Ore reserves are said to be sufficient for two years' operation of the firm's 100-ton mill. Development work at the Hinkson-Bishop properties also is planned for this year. O. T. Itness, Tacoma, Washington, is president.

Stoping of lead-silver ore at the **Silver Syndicate** mine, Shoshone County, Idaho, is at a minimum because of the low price of lead. The working force averaged only three men daily in one stope during 1959 and production amounted to only 3,843 tons of ore, compared with 12,303 tons in 1958 and 19,852 tons in 1957. Output last year averaged 7.5 per cent lead and 12.5 ounces of silver per ton. **Sunshine Mining Company** is the operator. W. M. Yeaman, Yakima, Washington, is president of Silver Syndicate, Inc.

The Lucky Friday silver-lead ore body, Shoshone County, Idaho, has been proved for a strike length of 1,487 feet on the bottom level, which is 3,050 feet below the adit. This is the greatest length yet developed. The ore body, only 25 feet long at a depth of 300 feet, has lengthened out with each deeper level opened. Diamond drilling of the vein's walls is under way. Mine output has been increased to supply the new Lucky Friday concentrator, which has a rated capacity of 500 tons daily. The mill is on a three-shift, five-day-per-week basis. A record 69,428 tons of ore was milled in 1959, all of it at the Golconda custom mill. The ore averaged 16.2 ounces of silver, 9.4 percent lead and 1.3 percent zinc to the ton. Ore reserves were increased to 1,373,132 tons from 799,627 tons. A sand-filled system, using mill tailing to fill stoped areas, went into operation the same time as the new mill—February 8. So did a conveyor belt system capable of transporting 200 tons of ore hourly to the mill or waste rock to the dump. **Hecla Mining Company** has been operating the property since obtaining control of **Lucky Friday Silver-Lead Mines Company** early last year. L. J. Randall, Wallace, is president of both firms.

Peter Mulholland, Elk City, Idaho area prospector, has announced plans to organize a company to develop placer claims containing uranium-bearing gravel.

Golconda Lead Mines' custom mill, Shoshone County, Idaho, has been placed on a standby basis until a new source of ore becomes available to replace Lucky Friday mine ore, now going through the new Lucky Friday mill. Golconda has taken preliminary steps which may lead to further exploration of adjoining **Square Deal Mining and Milling Company** and **United Lead-Zinc Mines Company** holdings.

A new vein 10 feet in width and showing galena was crosscut by **Clayton Silver Mines**, Custer County, Idaho, in drifting to its North ore body on its new 800-foot level. The structure has not yet been drifted out. Installation of two additional pumps solved the problem of an increased water flow which followed the Yellowstone Park earthquake of last August. Mine output in 1959 totaled 26,279 tons of lead-silver-zinc ore. Work projected for this year includes completion of the 800-level development, preparation of stoping areas, and diamond drilling of areas favorable to ore deposition. Norman M. Smith, Wallace, Idaho, is general manager.

Newest mining and milling operation in Shoshone County's Coeur d'Alene district in Idaho is the Mountain Goat Lease north of Wallace. Since leasing the property from **Day Mines, Inc.**, four years

Fiberglas Bags Reduce Air Pollution

One of the latest filtering methods used by industry to control air pollution is a battery of bags made of woven Fiberglas fabric. Pictured here are some of the 792 bags installed by Bethlehem Steel Company to overcome the problem of electric furnace dust at its West Seattle, Washington, plant, which has two new electric-arc steelmaking furnaces. The silicone-treated glass fabric bags, 11½ inches in diameter and 25 feet long, have withstood temperatures up to 550°F. an important consideration for most industries. Very resistant to chemicals, the bags do not require shaking like other filter bags, will not shrink, stretch, or lose permeability. The "bag house" shown here was designed by Western Precipitation Corporation of Los Angeles, California; fabric is made from yarn by Owens-Corning Fiberglas Corporation.

ago, W. C. Kennedy and Herbert Zanetti, both of Wallace, have developed an estimated 100,000 tons of zinc-lead-silver ore. Production has been 100 tons daily since mid-December. Two veins are being stoped on two levels. Ore is trucked to the Rex mill by **Zanetti Brothers,** who sold it to the lessees last October. The mill is on a three-shift basis under supervision of Robert A. Rice, Osborn. Zinc concentrates go to the Bunker Hill zinc plant at Kellogg; lead concentrates to the Asarco East Helena, Montana, smelter.

The **Silver Summit** mine, Shoshone County, Idaho, owned and operated by **Hecla Mining Company,** yielded 29,422 tons of ore assaying 32½ ounces of silver and 0.80 percent copper in 1959. Much of the output resulted from ore developed through extensions of small ore shoots above the 2800 and 3000-foot levels. Exploration on the 1750-foot level so far has yielded only narrow mineralization. Stoping from the 3000-foot level in **Rainbow Mining and Milling Company** ground yielded 4520 tons of ore, averaging 25 ounces of silver and 0.57 percent copper.

The old **Crescent** mine, in the silver belt of the Coeur d'Alene mining region east of Kellogg, Shoshone County, Idaho, is yielding more silver than at any time since it was returned to production in 1955 by the **Bunker Hill Company.** Output was 400 tons daily in a recent week. Output in 1959 totaled 24,934 tons of ore containing more than 500,000 ounces of silver. Silver production in 1958 was less than 350,000 ounces.

The Bunker Hill mine, Shoshone County, Idaho, one of the United States' largest, in 1959 yielded 445,369 tons of ore from which 32,792 tons of lead, 11,676 tons of zinc and 1,992,991 ounces of silver were recovered. Ore reserves declined slightly to 2,953,925 tons. The 1959 production was 25 percent higher than in 1958 although below pre-recession levels. The **Bunker Hill Company,** which owns and operates the mine, also has milling, smelting and refining facilities at Kellogg. It recently started producing zinc oxide, zinc anodes, and die-cast alloys, and will start producing phosphoric acid this summer.

Clay mining on the outskirts of Moscow, Latch County, Idaho appears likely. **The Ruby Company,** Boise, formerly the **Simplot-Muir Company,** has leased five blocks of land covering 360 acres following the taking of good-looking samples. **J. R. Simplot** Company recently put a new clay processing plant into production at Bovill, in the same county.

The Blackbird cobalt mill at **Cobalt,** Lemhi County, Idaho, has been sold to **Machinery Center Company** of Salt Lake City for disposal following completion of stockpiling ore for recovery of copper values. The mill-run was expected to be completed about mid-April. The mill was built by **Calera Mining Company,** a subsidiary of **Howe Sound Company,** which led the country in production of cobalt until the federal government stopped buying domestic production. For the last few months, cobalt values have been allowed to go into the mill tailing pond along with other waste.

Western Silver-Lead Corporation has levied an assessment of ½-cent a share to provide funds to maintain its silver-lead claims east of Wallace, Shoshone County, Idaho, and uranium interests in Utah. The firm's headquarters are in Wallace.

Golconda Lead Mines' concentrator west of Wallace, Shoshone County, Idaho has been placed on a standby basis until sufficient custom ore becomes available for a profitable custom operation. Most of the 71,000 tons of ore treated by the mill in 1959 was mined at the **Lucky Friday** mine which recently put its own new 500-ton concentrator into operation. The **Golconda** lead-zinc mine remained idle throughout 1959 but the management is considering exploration of the adjoining **Square Deal** and **United Lead-Zinc** properties providing base metal prices warrant. Golconda owns 155,000 shares of stock in **Lucky Friday Silver-Lead Mines Company.** Wray Featherstone and H. F. Magnuson, Wallace, are president and vice president, respectively.

The **Star** mine, near Burke, Shoshone County, Idaho, will be deepened 200 feet to open a new 6500-foot level and crews will go even deeper if the price of zinc justifies. A sinker hoist has been installed on the bottom 6,300 level and work is to proceed on a one-shift basis. Production at Idaho's largest zinc producer has been increased by 100 tons daily to approximately 950 tons to help supply additional zinc concentrates for the Bunker Hill electrolytic zinc plant at Kellogg. The Star mine is owned by the **Bunker Hill Company,** which also is stepping up output of zinc at its big lead-silver-zinc mine at Kellogg. Some old zinc stores are being reopened so as not to disturb the normal output of lead-silver ore. The Star mine is operated on a fee basis by **Hecla Mining Company,** which formerly had a half ownership.

MONTANA

The ferrochrome pilot plant of **American Chrome Company** at Nye, Montana, produced 2,100 tons of ferrochrome during 1959. According to Willis A. Swan president, chromite reserves are sufficient for many years of operation and it has been demonstrated that they can be used to provide products currently required in volume by the steel industry. When the present government contract ends in 1961, the company will own and have under lease all the facilities to continue a mining and smelting operation. Current operations are improving the firm's financial position so that entry into the ferro-alloys industry on a steady basis is anticipated. The company is 87.5 percent owned by **Goldfield Consolidated Mines Company.**

The underground mines of **Anaconda Company** in Butte, Montana, are now nearing full production with completion of repair work at the **Kelley** and **Mt. Con mines,** following the end of the strike.

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Production at the **Berkeley** pit is at the required schedule.

The Obelisk Exploration Company has dewatered the 220-foot winze in the old **Obelisk** mine near Basin, Montana. Some high grade silver ore was encountered as remnants in workings left by the old timers. Plans call for exploration at the lower levels to attempt to find more high-grade silver ore.

The Easton-Pacific Riverside Company is now exploring gold bearing veins on the lower tunnel level of the old **Easton-Pacific** mine near Virginia City, Montana. According to reports, encouraging results are obtained by drifting on these veins. The development ore, high in silica, is being shipped to the smelter in Anaconda.

Geological mapping for the Kootenai-Flathead mineral resources survey will be extended into additional quadrangles this year including the Ural and Thompson Falls sections of the Troy-Libby area. The survey is being sponsored jointly by **Pacific Power and Light**, the **Great Northern Railway** and the **Montana Bureau of Mines and Geology.**

Thorite ore from the **Sawyer Petroleum Company** mine on the Idaho-Montana border has been processed by a new method into a high purity chemical product assaying well over 80 percent contained thorium oxide. First samples of the product, in hydrate form, have been shipped to purchasers from the pilot plant of Sawyer's consulting chemists, **Techmanix Corporation** of Salt Lake City.

In Montana, **Haco Inc.**, a Billings mining firm, and **Multi-Mineral Products Corporation,** also of Billings, have recently been chartered by the secretary of state. Articles of incorporation for Multi-Mineral Products, a million-dollar company, were signed by H. Mack Brownlee of Gilford, Henry J. Miller of Havre, Leo Farley of Coalstrip, Henry Larsen of Forsyth, L. D. Howard of Billings, John R. Graham of Red Lodge, and Tom Koyama of Hardin.

Aluminum metal production capacity will be increased this summer to 100 percent of capacity at the Columbia Falls, Montana, plant of **Anaconda Aluminum Company,** subsidiary of **Anaconda Company.** The plant, only Anaconda installation for making aluminum metal, is now operating at 87.5 percent of capacity, producing 52,500 tons yearly. Anaconda's increase to about 60,000 tons yearly was preceded by similar action by other United States and Canadian producers. Operations at the mill were resumed in mid-February after a 181-day strike.

Spokane National Mines, Inc. has a crew of eight working at the old Bannack gold mine, west of Dillon, Beaverhead County, Montana. They have widened the adit in places, retimbered where necessary, installed an air compressor and other machinery preparatory to returning the mine to production. Some of the equipment has been purchased and some brought from the **Sunset Mines'** camp on Pine Creek in northern Idaho's Coeur d'Alene mining region. **Sunset Mines** was taken over recently by merger and Spokane National has let a contract to E. R. Fruin, Spokane, Wash., to move the 120-ton-capacity Sunset mill to the **New Departure** silver mine near Bannack. The Spokane firm plans to add equipment to increase the milling capacity to 150 tons daily. George Allison, Spokane and Casper, Wyoming is company president.

WASHINGTON

At the **Gold Dollar** ore body of **Day Mines, Inc.**, mined by the lessee, **Knob Hill Mines, Inc.**, 42,006 tons of high-grade gold-silver ore was mined during 1959. Although development work begun late last year on a new, low level, the 11th, did not prove encouraging, since then better ore has been encountered which reveals a minable length of 325 feet and a width of 11½ feet. The property is in the Republic district of Ferry County, Washington, where Day Mines and another mining company last year began joint development of separately-owned nearby properties. Nothing of commercial value has been disclosed so far in these properties.

Shipping a copper-gold-silver concentrate to the Tacoma, Washington smelter and stockpiling tungsten until prices improve is planned by **Paymaster Mines, Inc.**, at Hunter Mountain northwest of Pateros, Okanogan County. The firm is headed by Paul Rogstad, Pateros, who with associates leased the Holden-Campbell group of claims in 1958. They have reopened the 800-foot Hunter tunnel, driven between 1892 and 1900, and are driving an air raise. They also have constructed camp buildings and ore bins and installed a 50-ton gravity-type mill.

A third production level has been put into operation at the **Grandview** mine, Metaline mining district, Pend Oreille County, Washington. A new lower 650-foot level was opened by an inclined shaft sunk at a point 3,000 feet from the main operating shaft. Sixty men are employed five days a week in mining and milling operations and production averages about 19,000 tons of ore monthly. J. W. Currie is resident manager for **American Zinc, Lead and Smelting Company.**

Kennecott Copper Corporation reports that the Glacier Peak, Washington, copper-molybdenum-tungsten deposit under exploration by its subsidiary, **Bear Creek Mining Company**, looks better after every summer's drilling. However, it is difficult to predict when the property will become an actual producer.

Pend Oreille Mines and Metals Company is increasing production at its Metaline District zinc-lead mine to reach rated capacity of 2,400 tons of ore daily at its East Side mill. Zinc concentrates are shipped to the Bunker Hill electrolytic zinc plant, Kellogg, Idaho. Jens Jensen, Spokane, is president.

Huge Dryer Goes To Chile Exploration Co.

Shown loading for transport to South America and the world's largest open pit copper operation, this 52-ton STANDARD Rotary Dryer will be used to process copper concentrates at the Chuquicamata mine of the Chile Exploration Co., a subsidiary of The Anaconda Company.

The 10-ft. by 60-ft. dryer is a parallel flow, direct-fired type, designed and built in the STANDARD Los Angeles plant.

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Surigao to Build Mindanao Copper Concentrating Plant

Surigao Consolidated Mining Company plans to start construction this year on a copper concentrating plant that will have a capacity of about 400 tons daily. The plant will be located on copper property acquired in Zamboanga del Sur province, Mindanao Island, where active exploration has been under way for the last year.

Development work by diamond drilling shows favorable results, with ore samples assaying from 1.50 to 5.33 percent copper.

Surigao is also developing two iron ore properties in the province, where development work has reportedly disclosed more than 5,250,000 tons of reserves. Japanese steel companies have shown interest in development of both copper and iron properties but Surigao is negotiating only for development of the iron ore properties with assistance of Japanese firms.

The company reportedly has in storage at its gold mine in Surigao province on Mindanao machinery and equipment which it acquired during the last few years for erection of a complete copper concentrating plant.

Grouting Program to Start At Canadian Potash Mine

A grouting program to preserve and secure the shaft at its Saskatoon mine operation is being undertaken by Potash Company of America Ltd. The project, which will cost about $900,000 and require a year to complete, will be carried on throughout all sections of the shaft by Cementation Company (Canada) Ltd.

The entire area was frozen prior to the sinking of the shaft. Although refrigeration has been removed from a portion, the Blairmore section remains in a frozen condition which could, through a thawing and freezing action, cause deterioration of the concrete lining. Since the area contains several water-bearing zones, the company decided to effect a seal of the lining's exterior surface by the grouting process.

The Canadian subsidiary of Potash Company of America began sinking its 3,000-foot shaft in 1955.

Swedish Mine Uses One-Step Crushing-Grinding System

At the Vassbo mine of Bolidens Gruvaktiebolag in Sweden, which started production early this year, a one-step system of simultaneous crushing and grinding of the ore has been developed. Ore reduction is carried out in a wet grinding 22 by 7-foot Hardinge cascade mill.

The mill, designed for Boliden by Hardinge Company of York, Pennsylvania, was manufactured by Loesche Harzerkleinerungs-und Zementmaschinen K. G., Dusseldorf, Germany. Basic control features are a varispeed drive system, developed by Boliden, and an automatic system of hydrocyclones, used for classification in two steps. Grind is 80 percent minus-80-microns. The ore is very abrasive causing a normal wear of steel grinding media of about 0.45 pounds per kilowatt hour.

Located in northwestern Dalecarlia, the mine is expected to have a yearly output of 150,000 tons of ore containing 6.0 percent lead. An estimated production of 12,000 tons of lead concentrate will be smelted at the company's lead smelter at Ronnskar, Vasterbotten.

A transversal room and pillar stoping method will be used for mining. The orebody is a flat layer of quartsitic sandstone.

Surface plants at the operation include a 500-ton-per-day grinding and flotation plant, shaft building with hoist on top, ore bins, an office, and maintenance shops, all combined in one building block.

JAPAN—Construction of a sulphuric acid plant was started in April by **Sumitomo Metal Mining Company** at its **Kunitomi** mine in Hokkaido, which currently produces 1,000 tons of crude copper ore and 450 tons of electrolytic lead monthly. The new plant, scheduled for completion in a year, will have a monthly capacity of 2,200 tons. The C. C. C. system will be used to convert sulphurous anhydride into concentrated sulphuric acid to be sold to consumers in Hokkaido.

MALAYA—**The Perak Iron Mining Company** is building a conveyor belt system to load iron ore direct from shore to ship at the mouth of Dinding's River, near Lumut, State of Perak. The $1,500,000 project will cut the distance the ore must travel from 110 miles to 66 miles. The system includes an 1,800-foot ramp to carry the conveyor belt from ore bins on shore to a mid-stream point where freighters will receive ore direct into their holds. Fleets of trucks will take the ore from the mine to storage bins.

IRAN—Experts from **Scandiaconsult,** Swedish consulting engineers' firm, have been studying the Azna steel plant project. Sven Hultquist, managing director, has submitted a report of findings to the Ministry of Industry and Mines. Indications point toward a contract with the **Demag-Krupp** group of Germany in the near future.

TURKEY—The $15,000,000 credit to the Turkish government from the Export Import Bank for expansion of steel and iron capacities was finalized in March. The money was loaned to the Turkish Iron and Steel Industries of Karabuk which will triple present steel ingot production to 600,000 tons annually. Iron ore production will increase from 500,00 to 1,100,000 ton a year. Materials and services to be bought from the United States include equipment for a steel fabricating shop, mill machinery, and equipment for new iron and steel foundries.

REPUBLIC OF KOREA—Production of tantalum ore of comparable grade to that of Africa was begun recently by the **Tanlok Mining Company** in Cholwon County. The mine has been previously worked by Japanese soldiers and later by Russian military forces.

Dredging Creates Black Lake Asbestos Mine

After more than 51 months of continuous operation, the dredge Fleur de Lis has completed its job of creating an asbestos mine out of the 500-acre Black Lake in Quebec. The mine, which is capable of a 100,000-ton output per year, began producing in October 1958 while the dredge was still pumping out the lake bottom. Working its way down more than 560 feet, the dredge removed over 31,029,000 cubic yards of silt and overburden to uncover the asbestos deposit, pumping over 75,000,000,000 gallons of water at the rate of 45,000 gallons per minute. Two tugs served as icebreakers during the winter so operations could continue year-round. The mine and adjacent mill, visible in the picture's background, are operated by Lake Asbestos of Quebec, Ltd. subsidiary of American Smelting and Refining Company. The project lies in the center of Quebec's asbestos-producing area around Thetford Mines, which contributes about 75 percent of the free world's supply of asbestos fibre.

grinding
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drying

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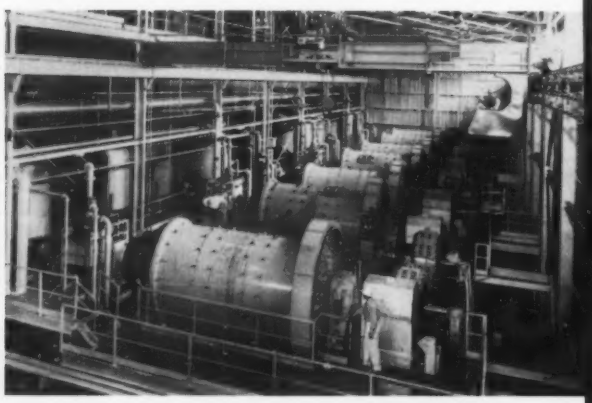
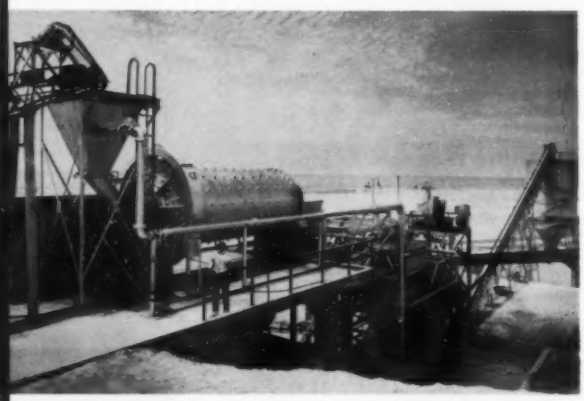
● 7—10'x14' Marcy Rod Mills.
The Marcy Rod Mills take a 1¼" feed, grinding to approximately 8-mesh.



● 7—8'x13' Marcy Ball Mills.
The Marcy Ball Mills are regrinding concentrates, with feed 55% minus 325 mesh, grinding to 85% minus 325 mesh.



● 7'x16' Marcy Heavy Duty Scrubber.
The Marcy Scrubber washes a mixture of coquina shells and pebbles; minus 10" feed. Marcy principle of small diameter, long length scrubbers gives maximum scrubbing efficiency with less horsepower.

◑ 3—23'-6" I.D., 4 Hearth Skinner Furnaces.
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Copper Deposit Located In Northeastern Turkey

Location of copper pyrite ore bodies at Lahanos in northeastern Turkey about 10 kilometers from the Black Sea coast has been announced by Maden Tetkik ve Arama Enstitusu, Turkey's Mineral Research and Exploration Institute. Reserves proven by drilling in an area of about 37 acres amount to 8,600,00 tons. The pyrite contains copper, zinc, and a little lead with a Cu:Zn ratio of 3:2.

Exploration on the coastal range from the vicinity of Samsun east to the Russian border indicated presence of minerals. Numerous relics of old mines and dumps discovered suggested extensive prospecting and mining activity in ancient times.

In 1956 the Institute began renewed exploration in this area concentrating on two occurrences near Tirebolu (Vilayet Giresun). One of these is the Lahanos deposit, where the pyrite bodies are located in a highly silicified and brecciated dacitic lava flow. The occurrence is about 700 meters above sea level; ore is found at 160 to 200 feet below surface, approximately 35 feet thick. Open-pit mining can be used in some sections.

According to its stratigraphic position, the lava is probably contemporaneous with the ore-bearing dactite of the Murgul copper mine, most important in Turkey. Enrichment of ore in the Lahanos region is always found at the hanging wall contact against an overlying tuff series.

PAKISTAN—**Pakistan Steel Corporation Ltd.** of Karachi, only lessee holder of iron deposits in this country, is making preliminary studies in preparation for constructing a steel plant. Initial plans call for a plant with a 60,000-ton yearly capacity. Ore available in considerable quantity is magnetite and hematite. Currently the corporation is investigating various sponge iron processes to use in the new plant.

CYPRUS—Production from the **Mavrovouni** mine of the United-States-owned **Cyprus Mines Corporation** during 1959 was 829,741 long tons, compared with 817,710 tons in 1958. Mill production for the year was 104,669 dry long tons of copper concentrates; 2,733 of cement copper; 181,892 of cupreous pyrite, and 453,115 of flotation pyrite. Output included 9,211 ounces of gold and 87,922 ounces of silver in copper concentrates. Cyprus Mines has its home office in Los Angeles, California and a mine office at Skouriotissa, Nicosia, Cyprus. In addition to the Mavrovouni mine which was the only one operating last year, Cyprus holds leases at Skouriotissa (5.67 square miles), Mathiati (13.50 square miles) and Apliki (4.93 square miles). The Mavrovouni lease covers 7.63 square miles.

INDIA—By a recent agreement with the Japanese Steel Mission, India will supply Japan with 4,000,000 tons of ore yearly from the Bailadila iron ore project in the Bastar district of Madhya Pradesh in which Japan is collaborating. The ore is to be supplied starting in 1966 and continuing for a 15-year period. The project includes development of the mine, a railroad connecting the mine with Visakhapatnam, and improvement of port facilities there. Japan reportedly has offered some $21,000,000 credit for purchase of mining machinery. By previous contracts India is exporting to Japan 7,200,000 tons of ore between 1957 and 1962, as well as 2,000,000 tons yearly for 10 years for use in Japan's steel mills.

JAPAN—To lower its nickel production costs, **Sumitomo Metal Mining Company** will change its raw material from low grade New Caledonia ore to sulphide nickel ore supplied by **Giant Nickel Mines Company** of Canada. Since the Canadian ore requires different treatment, Sumitomo is building a new 100-ton-per-day nickel mill at its Nihama smelter, at a cost of 100,000,000 yen. The new plant, started in March and scheduled for completion in September, will permit a monthly output of 300 tons. Present production is 250 to 270 tons of nickel ingot per month.

MALAYA—**The Sri Menanti Iron Mining Company** will start mining operations on 500 acres of land at Sungei Sayang, near Gunong Ma'akil, Yong Peng, Johore.

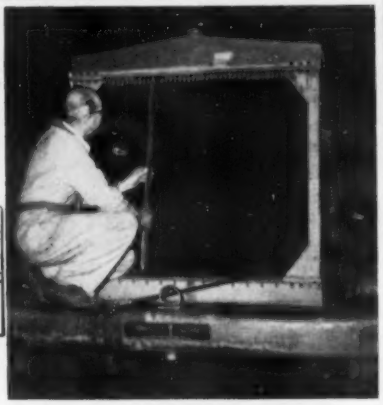
THAILAND—At the recent Bangkok conference of the Economic Commission for Asia and the Far East, the **ECAFE** committee on industry and natural resources asked for a regional geological survey center to study development of mineral resources. The group suggested holding a symposium soon on the development of bauxite resources. Another ECAFE group, the sub-committee for mineral resources development, held its fourth conference in Tokyo April 26 through May 4.

INDIA—**Assam Sillimanite Ltd.** plans to build a refractories plant with an initial capacity of 44,720 tons per year. The firm, in collaboration with a German firm and assisted by the World Bank, has obtained government permission for investment of $1,400,000 in plant and equipment. Import of refractories has increased and with continued development in steel plants, India's requirements will continue to rise. The Assam concern is also expanding its mining operations to supply the refractory industry, and plans to acquire deposits of quartzite, chrome ore, magnesite, steatite, talc, kyanite, and fire clay.

INDIA—Exploration drilling at the **Khetri** copper mines in Rajasthan, 80 miles from Jaipur, is scheduled for completion soon. Exploration is conducted by the Indian Bureau of Mines assisted by mining experts from the United States and Poland. Quality and percentage of the copper indicates it could be mined on a commercial scale, and a copper smelter will probably be built in the Khetri area soon.

BURMA—Mineral exports from the Tavoy district in the first nine months of 1959 totaled 1,319.85 tons, comprising 433.25 tons of wolframite concentrates; 860.60 tons of tin, and 26 tons of other minerals. Total exports in 1958 were 1,495.65 tons. In the Mergui district exports in the same period totalled 577.25 tons, and in 1958, 391.20. Tin and wolframite concentrates were the principal exports from there also. Some of the **Tavoy Tin Dredging Corporation Ltd.** properties, including the dredge in Tavoy, have been acquired by a local company, which is continuing production.

NEW RADIATOR PROVEN ON MESABI IRON RANGE



Withnell tube radiators have been proven on the Minnesota iron ranges over a three year testing period. Many of these radiators have provided over 8,000 hrs. of service and are still in use.

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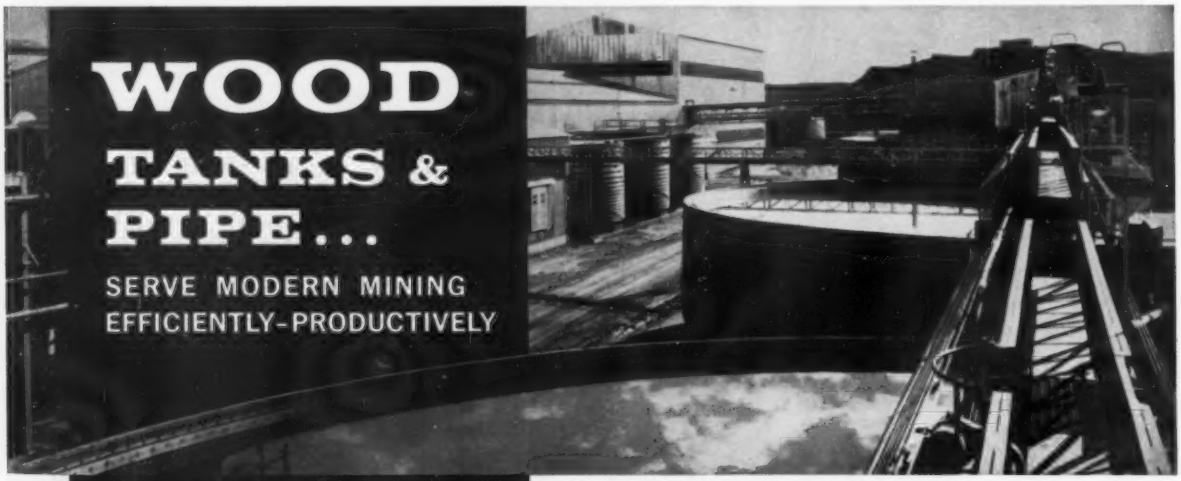

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NORTH AMERICA

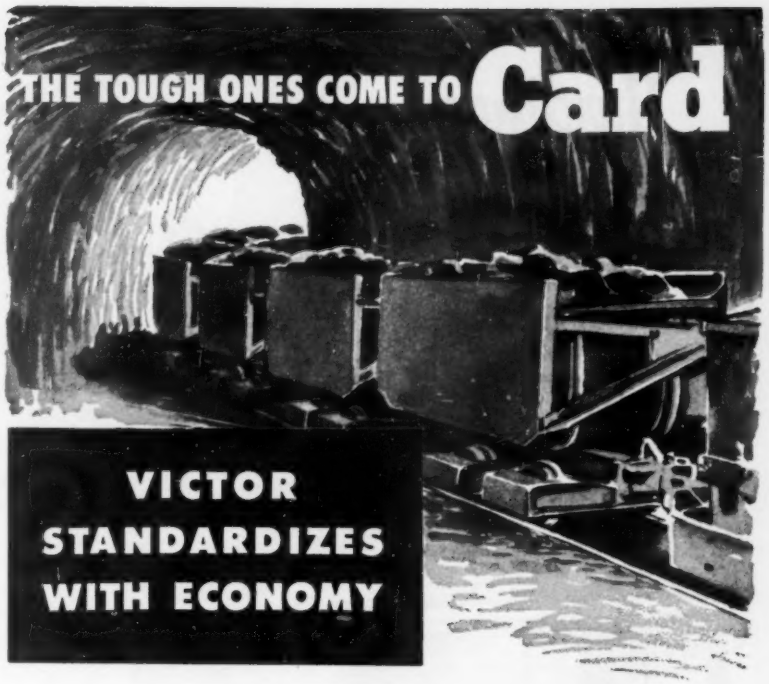
QUEBEC—In Mid-April **Portage Island (Chibougamau) Mines Ltd.** started diamond drillling with six machines on three levels to drill holes through the ore zone and then complete inclined holes to outline the ore at 50-foot intervals. The line drive on the 400-foot level has about 200 feet to go, on the 550-foot level, 350 feet, and on the 700-foot level, 200 feet. Drifting was discontinued in order to complete the drives, each about 1,500 feet, on all levels as quickly as possible. Limited diamond drilling on the various levels has indicated ore varying from 5.96 percent to 1.86 percent copper, and gold content ranging from 0.185 to 0.05 ounce per ton.

ONTARIO—**Denison Mines** is the new company to emerge from the amalgamation of **Consolidated Denison Mines** and **Can-Met Explorations** recently. Operations at Can-Met are being suspended but no schedule has been set for terminating various phases of its uranium mining and milling project. At **Consolidated Denison,** the company had recently announced expansion of its exploration program to world-wide scope. Currently active in many areas of Canada, the firm has recently acquired property in the Montpray-Duprat area north of Noranda, Quebec. Its exploration division will extend investigation to Alaska, Ireland, France, Spain, North Africa, Brazil, Chile, Bolivia, Argentina, and Venezuela. The program will include non-metallics as well as a search for metallic mineral deposits. Efforts will be based chiefly on geological knowledge with areas of known mineralization receiving most emphasis. The exploration division, headed by Dr. S. W. Holmes, is headquartered at 360 Bay Street, Toronto.

SASKATCHEWAN—**Sico Mining Corporation** is expanding its program with detailed geophysical work and diamond drilling to outline additional nickel-copper-platinum ore bodies on its 506-square-mile lease in the Rottenstone Lake area north of La Ronge. Airborne surveys have been completed, and ground follow-up work will require about 10,000 feet of diamond drilling to comply with commitments. One ore body already indicated is estimated to contain some 50,000 tons grading up to 2.0 percent nickel. **Rio Tinto Canadian Exploration Ltd.,** and a third Canadian mining firm are associated in the program. Other Sico plans include further work in the Brownell Lake area and near Knight Lake.

ONTARIO—A new exploration office was opened at Port Arthur, Ontario, by **Phelps Dodge Corporation of Canada,** subsidiary of **Phelps Dodge Corporation,** large United States copper producer. The new office will be headquarters for the firm's northwestern Ontario exploration activities, primarily concerned with finding base metal deposits.

MANITOBA—A newly-opened pollucite ore deposit at the **Montgary** mine operation of **Chemalloy Minerals Ltd.** in the Bernic Lake area was inspected recently by a group of North American and European mineral experts. Said to



The Maiden Rock Mine of Victor Chemical Works first started using Card cars in 1950. Chosen design was a Granby type car of 57 cu. ft. capacity built on 24" gauge and featuring coil spring suspension. The phosphate rock being handled is relatively clean to handle, and the car design is unusually well suited. As a result, not a single Card car has ever had any significant repairs although some wheels have been replaced. Fifty-two of these cars are now in service, representing several re-orders over a four-year period.

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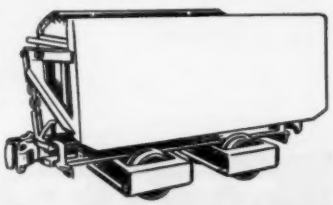

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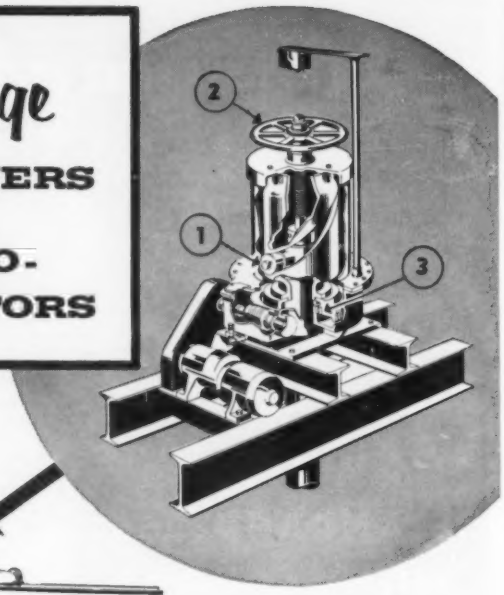

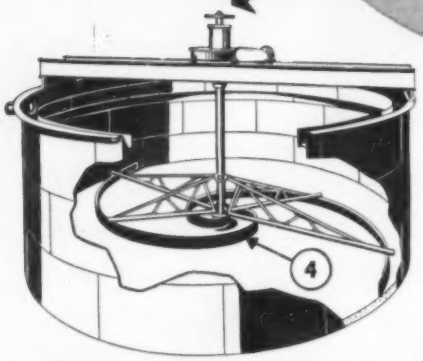

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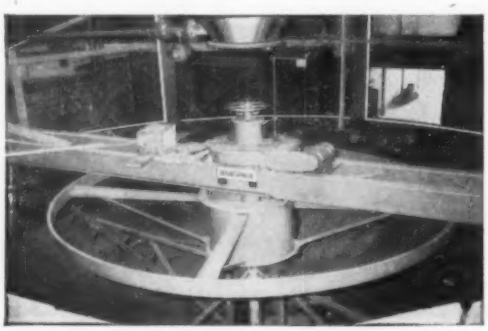

A 35'-diameter Hardinge Superposed Thickener installation in a Canadian lead-zinc concentrator. The sludge outlet for the upper unit can be seen at the top of the picture. Note froth ring on lower unit.

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be a large source of cesium, the deposit was discovered only two years ago and evaluated last June. The main ore body was reached recently from a shaft sunk 335 feet and a 700-foot cross-cut driven under the lake on a 285-foot horizon below the lake bottom.

QUEBEC—A 60-foot length of high grade zinc-silver-lead ore has been opened by **New Calumet Mines Ltd.** at its mine on Calumet Island, 60 miles northwest of Ottawa, Ontario. Opened by drifting on the 1,675-foot level, the ore, which is about 29 feet wide, is thought to be the downward extension of ore encountered by diamond drilling below the 1,200-foot level. Further drilling will get under way shortly.

EUROPE

ENGLAND—Increased export quotas in the June quarter for six producing members have been announced by the **International Tin Council,** which is permitted to take such action when it looks as though the countries will not export as much as they are entitled to. Countries affected are Bolivia, the Belgian Congo, Malaya, Nigeria, and Thailand. New quotas total 37,500 tons, compared with 36,000 tons in the March quarter.

FINLAND—A steel works company, with a share capital of 1,000,000,000 Finnish marks will be established by the Finnish government. A steel plant of considerable size at Raahe on the coast of the Gulf of Bothnia is among the first projects planned.

SPAIN—Following the start of operations at Spain's first uranium ore treatment plant, the Spanish government is offering 140 tons of uranium for sale to the International Atomic Energy Agency and its member nations. The plant is located at Andujar in southern Spain. The uranium available in 1960 (40 tons) will be in the form of sodium uranate (65 percent uranium). That offered during 1961 and 1962 (50 tons each year) can be provided in the form of anhydrous uranium trioxide of nuclear purity.

DENMARK — **A/S Dansk Tung-Sand Industry** is a new subsidiary of **Dansk Mangansulfatfabrik** formed to mine deposits of ilmenite and other beach sand minerals on the northern coast of Jutland. The company will have facilities for treating 15,000 metric tons of material each year.

SICILY—**The Montecatini Company** has begun operation of a potash mine near Caltinessetta that is described as "one of the largest and most modern in Europe." Named the **San Cataldo,** the mine is 650 meters deep. It is expected to enable to Italy to export potash, which it has been importing at about 50,000 tons yearly.

SWEDEN—Continued expansion until 1965 is planned by the **Luossavaara-Kiirunavaara Mining Company** (LKAB) which has invested 100,000,000, kronor yearly since 1951 on modernizing its mining operations. The company's output is

now 13,000,000, tons annually and is expected to reach close to 21,000,000 tons of iron ore yearly in 1965. Most of the ore comes from the **Kiruna** mine, world's largest underground mine.

NORWAY—A 25 percent production increase was achieved last year by **Norsk Jernverk,** Norway's state-owned iron and steel works at Mo-i-rana in northern Norway. Coupled with an average price increase of 10 percent over the past several months, the greater output should put the plant in a better financial position than in 1958-59, according to Dagfin Efjestad, director general. Pig iron production is up 35 percent, while steel output is 16 percent higher.

EIRE—The abandoned copper mines in Waterford will be site of renewed exploration work by a new company being formed by Canadian interests. Some years ago, **Explorers' Alliance** of Canada began exploration in that area.

BELGIUM—Germanium production capacity at the Olen works of **Societe Generale Metallurgique de Hoboken** has been increased to more than 60,000 kilograms of electronic grade germanium dioxide per year. An increasing amount has been converted into polycrystalline zone refined germanium metal and the range of production has been extended to include single crystals of intrinsic purity. Much emphasis is currently being placed on supplying doped single crystals to customers' specifications.

SCOTLAND — **The Weardale Lead Company Ltd.** has reached the 256-foot level in developing its **Stotsfieldburn** mine. This level, which is the limit of previous operations, will now be developed, since substantial ore reserves have already been indicated to the west. The company plans to start drilling soon to determine whether mineralization continues in the Whin Sill below present workings.

RUSSIA—Full development of the Kursk Magnetic Anomaly, said to contain vast reserves of iron ore, will be a project of highest importance in the U.S.S.R.'s current seven-year period. In the Belgorod district, where ore lies under a 500-meter rock layer, plans call for underground mines with an annual capacity of about 15,000,000 tons. Depth of the main shafts will be 700 to 800 meters. Initial steps for construction and operation at open-pit mines are also under consideration. The KMA reportedly has about 10 times more ore than the Krivoi Rog basin.

FRANCE—**Pechiney Company,** major French aluminum producer and fabricator, has opened its new 56,000-ton-yearly aluminum works at Pau. Power for the plant is supplied by natural gas deposits at Lacq in southwest France. Said to be one of the most modern in the world, the Pechiney works will increase France's yearly output of aluminum to 300,000 tons next year and 350,000 tons by 1963. Pechiney will give technical aid to Japan for constructing a similar 30,000-ton-yearly aluminum plant in that country.

CORNWALL—**Geevor Tin Mines Ltd.** milled 63,434 tons of ore last year to produce 683 tons of tin concentrate, the same as in the previous year. Mine expenditure was reduced because of a decrease in development footage driven, and lowered costs. A total of 8,567 feet was driven during the year. Grade remains consistent, averaging 24.1 pounds of "black" tin. Ore reserves stand at 202,542 tons, showing an increase of 12,000 tons.

YUGOSLAVIA—Recent prospecting in Kosovo and Mehohija in southwest Serbia reveals reserves of several different minerals—magnesite, asbestos, cobalt, manganese, iron and chromium—in addition to the lead and zinc mines of **Trepca.** About $2,000,000 has been invested in geological prospecting in the last three years. Magnesite reserves near the **Goles** mines and a new mine at Dubovac near Viciturn, have been enlarged. Reserves of asbestos estimated at 1,200,000 tons have been discovered at Picelj near Kosovoska Mitrovica. Cobalt has been located near Prizren, manganese near Novo Brodo, and iron in the Gnjilane area. In the immediate vicinity of the **Deva** mine near Djakovica, and in Brezovica, new reserves of chromium ore, amounting to over 40,000 tons have been discovered.

YUGOSLAVIA — Previously undiscovered deposits of quicksilver ore have been reported near Belgrade in the Avala mountains. Prospecting indicates that reserves are considerably greater than previous estimates of 70,000 tons of ore with about 0.4 percent quicksilver.

ENGLAND—At the tin mine of **South Crofty Ltd.** between Redruth and Camborne, Cornwall, a new flotation section is being added to the treatment plant for elimination of sulphide and sulphoarsenide minerals.

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AFRICA

LIBERIA—**Bethlehem Steel Corporation** of the United States is embarking on a joint venture with the **Liberian American-Swedish Minerals Co.** (LAMCO) to develop a large, high grade iron ore deposit located in the Nimba Mountains. The project will include mining and related facilities for producing 10,000,000 tons of ore annually. Initial production goal will be 4,000,000 to 6,000,000 tons yearly. A railroad about 165 miles long from the mine to the port and port facilities at Lower Buchanan are other phases of the program, in which Bethlehem will have a 25 percent interest.

REPUBLIC OF TOGOLAND—Preparations to start mining operations this fall are progressing at the tricalcium phosphate beds in the Akoumape region and extending into the Dagoati-vo-ative and the Kpagameaveta regions. A steel wharf to be used in loading ore concentrates is being constructed in France at the factory of **Seine-Maritime et du Trait** and the **Compagnie Francaise d'Enterprises,** Rouen. A Franco-American group, **Long** (U.S.) and **Hersent** (France) will install it. Two French firms, **Coignet-Togo** and **Paindavoine** of Lille are building a 700-meter bridge so that a railroad can connect the mine to the ore washing plant in Franchur la Lagune. Technicians from **Compagnie Togolaise des Mines du Benin** and **Comptoir des Phosphates de l'Afrique du Nord** are studying processes to raise the grade of the ore from 60 to 80 percent.

FEDERATION OF RHODESIA & NYASALAND—**The Messina (Transvaal) Development Company Ltd.** has disclosed the possibility that a hitherto unknown layer of copper ore lies under the main ore body of its M.T.D. (Mangula) in Southern Rhodesia. According to the company, the original conception of a series of tabular ore bodies may instead be an elongated layer of ore of irregular thickness and shape, with the possibility of a second layer below the main layer and following its contours. Entirely new intersections of ore have been located on the lower levels, ranging up to 2.49 percent copper over a width of 53 feet. In the Norah area, 230,000 short tons of better than average grade sulphide ore have been proved in the vicinity of the Brian shaft, while to the north of that, there is a possibility of some 1,000,000 tons of ore. The new Harry shaft is being sunk to carry out further underground development and drilling.

UNION OF SOUTH AFRICA—A development program has been initiated by **African Asbestos-Cement Corporation Ltd.** in its Kalkloof chrysotile property to establish reserves in new zones. The company, in which **Johannesburg Consolidated Investment Co. Ltd.** has acquired a substantial interest, recently built a grading plant.

MAURITANIA—The $190,000,000 iron ore project of the **Societe de Mines de Fer de Mauretanie** on the fringe of the Sahara desert has been backed by a $66,-

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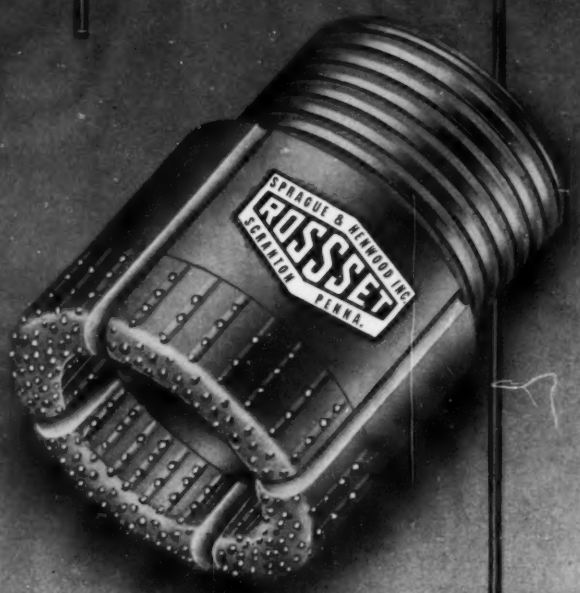

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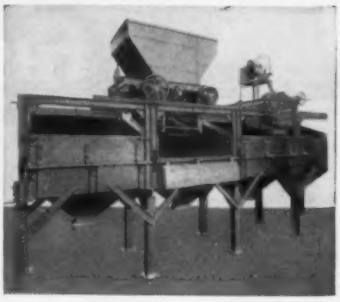

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000,000 World Bank Loan. Development plans include equiment to produce 6,000,000 tons of ore yearly and a 400-mile railroad to Port Etienne on the Atlantic, where port facilities will be built. Start of open-pit mining is scheduled to begin within two years. The Societe is a joint-stock company owned by a French government agency, private financial interests, and several European iron ore consumers. Ore is similar to high-grade Swedish and South American ore.

MOROCCO—A triple superphosphate plant scheduled to be started this year in Safi will have a capacity of 200,000 tons annually, cost about $20,000,000, and employ 400 to 500 persons. The project will be financed mainly by the government-owned **Office Cherifien des Phosphates** and the government-owned **Bureau d'Etudes et de Participations Industrielles** (BEPI) with private capital from European phosphate importers, according to Mohamed Lahbabi, who is director of BEPI. In addition to triple superphosphate, the new plant will produce sulphuric acid, probably using pyrrhotite from the **Kettara** mine operated by the **Compangie Miniere et Metallurgique** of Casablanca. Safi is only 50 miles by rail from the phosphate mines at **Louis Gentil** and exports 2,000,000 tons of phosphate annually. Water will be piped to Safi from the nearby Doukkala irrigation network.

SIERRA LEONE—An ore processing plant with a capacity of 110 tons of crude iron ore per hour will be built at Marampa for the **Sierra Leone Development Company Ltd. Woodall-Duckham Construction Company Ltd.** will erect the plant, valued at more than £300,000. Construction is to start in September and be completed by June, 1961.

MALAGASY REPUBLIC—**The Sand Treating Company** of South Madagascar (SOTRASSUM) recently started operation of a pilot plant to study methods for processing ilmenite, monazite, and zircon bearing sands. The plant employs a gravimetric wet process to obtain quartz-free concentrates that are dried and then magnetically sorted to obtain a marketable product. Anticipated output of the proposed permanent plant is 30,000 tons of ilmenite; 1,000 tons of monazite, and 1,500 tons of zircon per year.

SENEGAL—**The Senegalese Phosphate Company** of Taiba will mine the tricalcium phosphate deposit at Taiba, with a planned production of 700,000 tons yearly of 80 percent enriched phosphate. For the present the entire output will be exported to western Europe. Later it is hoped Senegal will have facilities for converting it into superphosphates.

LIBYA—**Fairchild Aerial Surveys, Inc.**, a wholly-owned subsidiary of **Fairchild Camera and Instrument Corporation,** has completed a 260,000-square mile aerial survey of southern Libya's barren, featureless, wasteland. Mapping was completed in spite of blistering temperatures, violent dust storms and completely unreliable base maps.

GHANA—A small shaft, to be known as the Ankobara shaft, will be sunk by **Ariston Gold Mines (1929) Ltd.** 2,000 feet north of its North shaft. The new shaft will facilitate exploration of the area between the present upper limits of the North ore body and the surface.

BELGIAN CONGO—**Societe de Recherches et d'Explorations des Bauxites du Congo (Bauxicongo)** is a new company formed to prospect for bauxite in the Lower Congo, near the proposed site of the hydroelectric power station at Inga. The new firm will have a capital of 26,500,000 Congolese francs.

NIGERIA—**Jantar Nigeria Company Ltd.** has committed its entire output of columbite for the coming year, with prices to be negotiated quarterly. The mine's primary tin deposits will be worked only on an experimental basis and cash resources are being conserved to meet the cost of this and to provide for further spending when the "Deep" area is reopened. When tin restriction ends, the company plans to try again to mine the "Basalt" deposit economically at a high production rate. An additional 2,000 tons of tin are estimated in that area.

FRENCH WEST AFRICA—The Sierra Leone Government Buying Office purchased £5,700,000 worth of diamonds in 1959, some £1,600,000 more than in 1958. Output of **Consolidated African Trust** is not included in this figure, since the firm sells its diamonds separately.

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INDONESIA—The first stage of a three-part iron and steel works will be started this year, the minister for development and reconstruction has announced. Partly financed by a U.S.S.R. loan of $117,500,000, a rolling-remelting project with an annual capacity of 100,000 tons will be erected in western Java. The second stage calls for a 50,000-ton-per-year furnace in the Sempung Lapung area in Sumatra, while the third phase will be a blast furnace in Kalimantan with a capacity of 250,000 tons annually. Half the material for the initial mill will be domestic scrap iron, the rest imported iron ingots.

QUEENSLAND—Another copper ore production record was set by **Mt. Isa Mines Ltd.** when its tonnage for four weeks in March totalled 157,629. Total ore hoisted, including lead-zinc ore, was 219,560 tons; lead bullion, 4,060 tons, blister output, 3,305; and concentrate shipped, 8,712 tons. During the fiscal year ended last June 30, total production was 63,879 tons of lead bullion (with 5,023,218 ounces of silver); 30,554 tons of zinc concentrates; 46,978 of blister copper, and 43,327 of copper concentrate, which were extracted from a total of 2,552,008 tons of ore. Substantially increased reserves of both copper and silver-lead-zinc ore resulted from exploration and development work during the year. In its continuing expansion program, Mount Isa will complete its new Mica Creek power plant, and sink a new main ore extraction shaft, rebuild its copper smelter to treat the expanded concentrate output, and enlarge its copper refinery at Townsville, completed last year. A mill for the rolling of wire bars into rods, combined with a plant for drawing and stranding copper wire, is under construction.

REPUBLIC OF THE PHILIPPINES—**Lepanto Consolidated Mining Company** plans to test another area on Mindoro Island, after the gold placer area tested near Davao, Mindanao, during 1959 was abandoned because the gravel turned out to be too low grade for commercial dredging.

NEW ZEALAND—**West Coast Company** is investigating a promising uranium deposit in Buller Gorge, where some deposits have already been proved. The new area is in the wild Buller Paparoa region.

REPUBLIC OF THE PHILIPPINES—Production of **Philex Mining Corporation** during February at its **Santo Tomas II** copper mine increased to 54,103 dry short tons of disseminated copper ore milled. Concentrates amounted to 1,442.32 tons averaging 26.56 percent copper and 0.851 ounce gold per ton. The concentrates were estimated to contain 753,418 pounds of copper and 1,209.08 ounces of gold with a total value of Pesos 609,232.

NEW ZEALAND—Revival of the Reefton district on the west coast of New Zealand's South Island as a rich producer of gold is expected soon. Representatives of the Canadian-financed **South Pacific Mines** are expected in the Inangahua district and it is believed that the company is linked with the **Redondo Exploration Company** which has started 12 areas near Reefton. South Pacific Mines is at present operating gold claims in the Thames and Waihi areas in the North Island.

NORTHERN TERRITORY—A higher treatment rate and improved recovery have been achieved by **United Uranium N. L.**, Moline, after modernization of its plant during the Christmas shut-down. Treatment rate is about 2,500 tons of 8-pound ore per four weeks, with oxide output about 20,000 pounds.

NEW SOUTH WALES—**Nullamanna Sapphires Pty. Ltd.**, located at Nullamanna about 10 miles north of Inverell, recently started production of sapphire. In one eight-week period the production was 221 ounces of corundum.

CENTRAL AUSTRALIA — Tungsten mining in the Hatches Creek area is fairly inactive because the value of tungsten has dropped and the government mill is not operating. Efforts are being made by **Pioneer Mines N. L.**, whose **Pioneer** mine is the only one active in the area, to secure additional capital in order to increase output of its mill and acquire other property in this district.

SOUTH AUSTRALIA — Construction plans for a zinc blast furnace installation are being made by the **Broken Hill Associated Smelters Pty. Ltd.** of Port Pirie. The furnace, similar to that being built at Cockle Creek, New South Wales by **Sulphide Corporation Ltd.** will cost about

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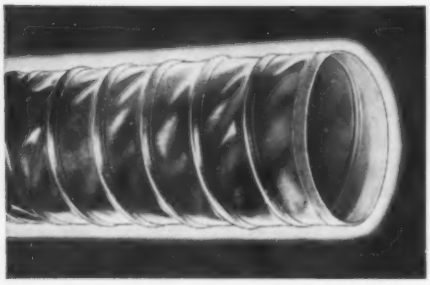

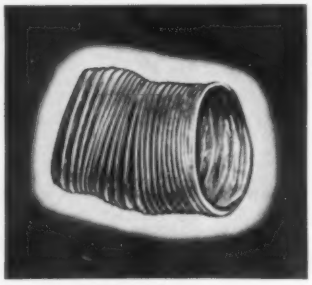

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£2,500,000, including an auxiliary plant. The installation will be primarily for recovery of zinc from stockpiled lead blast furnace slag averaging about 18 percent zinc. Broken Hill will also build a coke plant, costing about £750,000, to be supplied by the Coal Cliff colliery in New South Wales. Broken Hill's decision to build the new furnace probably resulted from the favorable outlook for zinc demand. Australia is expected to continue its progress as a zinc producer.

WESTERN AUSTRALIA—The mining division of **Howe Sound Company**, New York, New York, is engaged in a joint venture with Australian interests for lease and operation of a magnesite deposit in this region.

AUSTRALIA—Official figures for gold production in the Commonwealth during 1959 show a decline of 10,830 ounces from 1958, for a total of 1,089,574 ounces, but the year's output was still third highest from the 1954 peak. Western Australia continued as the main producer with 861,122 ounces. Commonwealth gold subsidy paid to producers in Australia and New Guinea, including Papua, totalled £788,495 compared to £753,528 a year earlier.

QUEENSLAND—Dredging operations by **Tableland Tin N. L.** produced 706 tons of tin oxide during the company's last fiscal year, some 77 tons more than in the previous year. Profit for the year, ended last June 30, was £A86,601, compared with £A60,052 for the year before. Australian dredging costs, said to be nearly 100 percent higher than for similar operations in Malaya, were blamed for the low profit, according to G. H. Watson, chairman of directors. The necessity for slime settlement also lowered profits of the company, which operates on Smith's Creek near Mt. Garnett.

NEW GUINEA—**Bulolo Gold Dredging Ltd.** in the nine-month period ending February 29 dredged and sluiced 4,317,135 cubic yards to recover 17,771 ounces of fine gold, compared with 3,702,005 yards and 15,442 ounces for the like period in the previous fiscal year. Value per yard is 14.41¢ compared with 14.59¢ the year before.

REPUBLIC OF THE PHILIPPINES—Iron ore shipments made by **Philippine Iron Mines, Inc.**, to Japan during February totalled 77,689 tons with a value of Pesos 1,356,835. January shipments were 85,041 tons with a value of Pesos 1,492,821. All ore was mined and shipped from the **Larap** mine of the company in Camarines Norte province, southeastern Luzon.

PAPUA—Intensive prospecting by **Pacific Island Mines Ltd.** in a 22-square mile area at Misima Island resulted in location of an extensive lode system carrying promising gold values. The new find is in virgin ground northeast of former mining areas. About 12,200 feet of trenching covering some 60 acres were completed in the three months ending March 1 and detailed testing to delineate lode structure is now in progress. Installation of a pilot plant is under consideration.

QUEENSLAND — An electronic ore sorter, said to be the first of its kind in the Southern hemisphere, was put into operation by **Mary Kathleen Uranium Mines Ltd.** in April. Tests indicate the sorter should eliminate up to 20 percent of waste from the mill feed. Latest estimate of ore reserves stockpiled and indicated within present boundaries of the open-pit mine total 4,357,300 short tons of 3.44 pounds uranium oxide per ton. Possible reserves adjacent to the open pit are 1,095,000 tons, assaying 3.59 pounds per ton. Total ore milled last year was 479,990 tons.

REPUBLIC OF THE PHILIPPINES—A promising future for Philippine production and export of metals is forecast by the **U. S. Bureau of Mines**, which is preparing a complete survey of metal production, consumption and commerce. Good prospects are seen for United States' consumption of chrome and copper, and for shipments of iron ore, copper, zinc and mercury to Japan. However, the Philippine gold output situation is less favorable. Expected chrome export total in 1960 and 1961 is 620,000 metric tons; mercury, 4,000 flasks of 76 pounds each in 1960, and 5,000 in 1961; copper, 60,000 to 65,000 tons by 1961, and iron ore, 1,500,000 tons in 1960 and 2,000,000 tons in 1961. With introduction of modernized zinc mining methods, the Bureau estimates Philippine exports should reach 5,000 metric tons in 1960.

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2—2¼ x5 Braun Chipmunk laboratory
HOPPER
1—Conveyco Truck dump station with 13'x20' grizzly hopper, tilting grizzly, 15'x15'x10' Hopper, 4'x8' recip. feeder, complete
CLASSIFIER
1—5'x25' Dorr DSFH, Rake, 5 HP motor
GEARMOTOR
2—100 HP West., 84 rpm, Falk Back stop, 440 V
GENERATOR
1—50 KW Caterpillar D-8800, 220/440 V, excellent
HOISTS
3—½ Ton Budgit, Electric 115 Volt
1—1 Ton P & H electric, 220/440 Volt 50' lift, excellent
1—2 Ton Wright electric, 220/440 V, exc.

HYDROSEPARATOR
1—36'x10' Process Engineers, steel tank, 10 HP varidrive, 220/440 volt
2—24'x8' Process Engineers, steel tank, 7½ HP varidrive, 220/440 Volt
JIGS
14—4 cell 42" Yuba jigs, Model M-8 complete with 3 HP drives
1—2 cell 42" Yuba jig, Model M-8
MILL
1—5'x10' Marcy ball mill, complete 100 HP motor 440 V, with controls
PUMPS
1—6"x8" Fairbanks Morse centrifugal, 2000 gpm, 300 HP, West. motor, magnetic drive & Regutron controls
1—14" Yuba Centrifugal 250 HP West. syn. motor, 440 volt
1—14" Yuba centrifugal 100 HP West. motor, 220/440 volt
1—16" Wintroath deepwell 2 stage, 2000 gpm, 100 HP syn. motor, magnetic drive and Regutron controls
3—6" Dorrco duplex diaphragm, model VM, 3 HP TEFC motor
2—8" Dorrco diaphragm, type W, 5 HP TEFC motor
3—6x6 Allis Chalmers sand, NRLOR 30 HP motor, 220/440 volt
2—16" Cascade sump pump, 7440 gpm, 30 HP, 440 V
SAND WHEELS
4—12½' x 4' Conveyco, duplex, steel tank, 2-20 HP West. gearmotor
SCREENS
1—9'dia. x 54½' Yuba Trommel heavy duty, 100 HP West. motor 440 Volt
4—4'x12' Tyler Ty-Rock, F-600, 10 HP Westinghouse motor
WEIGHTOMETER
1—36" Merrick Model E with automatic recorder
TRANSFORMER
3—833KUA Westinghouse Type SL, Class OA, 55,000 to 2400V.
POWER LINES
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4 Miles—2400V. Aluminum #2/0 complete

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1—40" x 20" Cedar Rapids

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1—15 KW Waukesha-Hesselman
1—30 KW Buda
1—75 KVA Caterpillar, D-13000
1—112½ KVA Caterpillar, D-17000
1—250 KVA Buda model 8D-CS-2505

THICKENERS
1—10' x 8' Wemco
1—15' x 8' Dorr
1—16' x 8' Dorr
1—18' x 9' Eimco
1—28' x 8' Dorr

AIR TUGGER HOISTS
1—Ingersoll-Rand Model DU
3—Ingersoll-Rand Model D6U
4—Ingersoll-Rand Model IH
14—Sullivan Model E-111
2—Ingersoll-Rand Model EUA
1—Ingersoll-Rand Model 10-H
4—Gardner-Denver Model MK
2—Joy "Turnbinair" Model F-113
1—Sullivan Model L-111
2—Ingersoll-Rand Model 10HR
1—Sullivan Model HA 3
3—Ingersoll-Rand Model HU

AIR SLUSHER HOISTS
3—Ingersoll-Rand Model A-4NNOJ
1—Ingersoll-Rand Model HNNIJ
1—Sullivan Model FF-211
1—Sullivan Model F-212

ELECTRIC TUGGERS AND SLUSHERS
1—5 HP Sullivan, 2 drum slushers
1—5 HP Sullivan Tugger
2—7½ HP Sullivan tuggers
1—15 HP Ingersoll-Rand size 15NN-IG, 2 drum slushers
1—30 HP Joy Double Drum Slusher
1—60 HP Sullivan 3 Drum Slusher
1—10 HP Sullivan A-312 3 Drum Electric Slusher
1—20 HP Sullivan AF-312 3 Drum Electric Slusher

BALL AND ROD MILLS
1—4' x 4' Marcy Ball Mill
1—4' x 4½' Hirsch Ball Mill
1—64½ Marcy Ball Mill
1—8' x 22" Hardinge Conical Ball Mill
1—3' x 8' Morse New Rod Mill
1—5' x 10' Denver Ball Mill

JAW CRUSHERS
4—2¼" x 3½" New Morse Lab Crushers
3—4" x 6" New Morse Lab Crushers
1—5" x 6" New Morse Jaw Crusher
1—6" x 7½" Hendy Crusher

FILTERS
1—3' x 4' Oliver Drum Filter.
1—3' x 6' Oliver Drum Filter.
1—4' x 2' Morse Drum Filter.
1—4' x 8' Eimco Drum Filter.
1—6' x 3' Dorrco Internal Type Filter.
1—6' x 2 disc Oliver Leaf Filter.
1—6' x 5 disc Morse Leaf Filter.
1—9" x 16" Kue-Ken No. 30 Crusher
1—10" x 20" Pacific Crusher
1—20" x 36" Diamond Roller Bearing, Steel Plate, Jaw Crusher

LOCOMOTIVES
2—1½ Ton Mancha "Trammers"
3—5 Ton Atlas Battery Locomotives
2—5 Ton General Electric Battery Locomotives
1—4 Ton Westinghouse Battery Locomotive
1—4 Ton General Electric Trolley Locomotive
1—4 Ton General Electric Battery Locomotive
1—6 Ton Goodman Trolley Locomotive
2—6 Ton Jeffrey Trolley Locomotive
2—6 Ton General Electric Battery Locomotives
1—7 Ton Atlas Battery Locomotive
2—8 Ton General Electric Battery Locomotives
3—8 Ton Ironton Battery Locomotives
1—9 Ton Whitcomb Battery Locomotive
4—10 Ton Atlas Battery Locomotives
2—10 Ton Jeffrey Trolley Locomotives
1—13 Ton Jeffrey Trolley Locomotive
1—13 Ton Goodman Trolley Locomotive
1—15 Ton Jeffrey Trolley Locomotive

FILTER PRESSES
1—24" Shriver
1—36" Merrill
1—36" Sweetland #12
2—4' x 10' Kelly

LABORATORY EQUIPMENT
2—2000 gram Denver flotation cells
2—Stearns-Roger lab batch ball mills
1—15" x 17" lab batch ball mill
1—2" x 6" Sturtevant jaw crusher
5—2¼" x 3½" New Morse lab jaw crushers
3—4" x 6" New Morse lab jaw crushers
3—8" New Morse disc pulverizers
1—9½" McCool Style D pulverizer
2—6" Iler pulverizers
2—Stearns-Roger lab pressure filters

COMPRESSORS
1—80 CFM Worthington, 6" x 5"
1—88 CFM Ingersoll-Rand, 7" x 5"
1—105 CFM Davey, 7-3/8" x 4-3/8" x 4-1/2"
1—105 CFM Jaeger, 2 stage.
1—120 CFM Ingersoll-Rand ER-1.
1—173 CFM Chicago-Pneumatic, 9" x 8"
1—179 CFM Ingersoll-Rand, 12" x 10"
1—447 CFM Ingersoll-Rand Imperial Type 10.
1—698 CFM Union, 60±, 16" x 12".
1—759 CFM Ingersoll-Rand, Imperial Type 10.
1—1085 CFM Ingersoll-Rand, Imperial Type 10.

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1—6-Cell (28x28) Denver Sub-A Flotation Machine.
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1—GD-10 Gardner-Denver Mucker, 18/24" Ga.
2—No. 12-B Eimco Muckers, 18/24" Ga.
2—No. 21 Eimco Muckers, 24" Ga.
1—No. 40-H Eimco Mucker, 36/24" Ga.
1—4½-Ton Atlas Battery Locomotive, 24" Ga.
1—6-Ton Goodman Battery Locomotive, 36" Ga.
2—8-Ton Atlas Battery Locomotives, 36" Ga.

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Rod Mill: 4x10 Hardinge; periph. end dis.
Ball Mill: 5 ft. dia. x 6 Colo.I.Wks.
Flotation: Wemco Fag 56 & 44"; Denver 32"
Filters: Eimco and American 3-Leaf 6 ft.
Sand Pumps: Wilfley, Wemco and Denver 2" & 3"
Portable Crushing Plants: Cedar Rapids 20x36 r.b. jaw crusher, etc., 30x18 rolls, etc. Also, 15x24 r.b. jaw crusher, 24x16 rolls, etc.
Crusher 15x30 Buchanan Blake Type
Crusher 10x16 Denver Eq. Co.
Triple Roll 30x18 Pioneer roll-crusher
Mine Hoist 50 hp Vulcan double-drum 440-v.

Paul F. Smith
39 W. Adams St. Phoenix, Arizona

24"x95' Hewitt Robins Belt Conveyor New
2—5'x8' Kennedy Van Saun Air Swept Ball Tube Mills with disc feeders, fans, piping.
2 Wemco 2M—HMS Plants
No. 56 and 7'x15' Marcy Ball Mills
10'x48" & 6'x36" Hardinge Ball Mills
4'x8' & 7'x15" Marcy Rod Mills
14"x28", 30x36 & 48"x72 Jaw Crushers
78"x36'6" Akins Duplex Spiral Classifier
5'x30' Ruggles Coles Rotary Dryer
8'x60' Rotary Dryer ½" Welded Shell
9'x162' Allis Chalmers Rotary Kiln
8, 12, 23, 25, 45, 60 & 100 ton GE & GM Diesel Electric Locomotives
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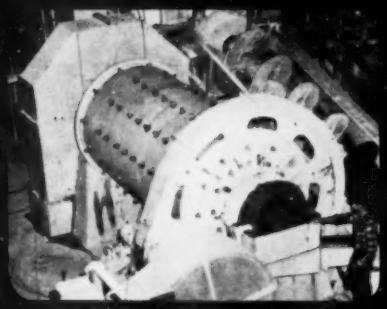
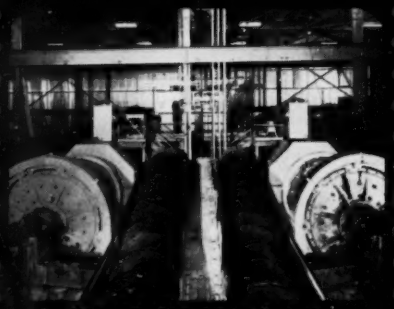
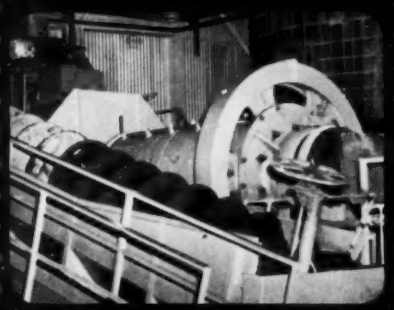


Gunnison Mining Company, Gunnison, Colorado

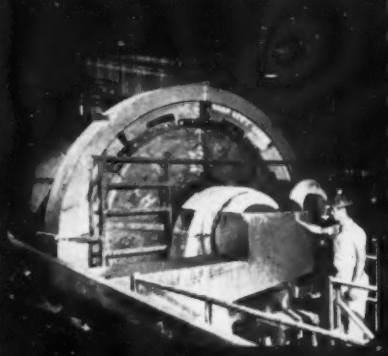


Homestake-New Mexico Partners, Ambrosia Lake District, Grants, New Mexico

Western Nuclear Corporation, Jeffrey City, Wyoming



Mines Development, Inc., Edgemont, South Dakota



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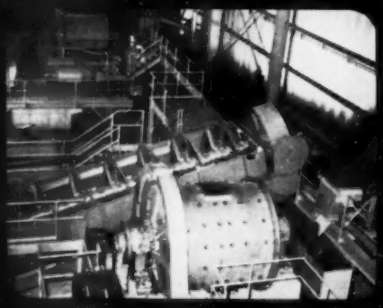
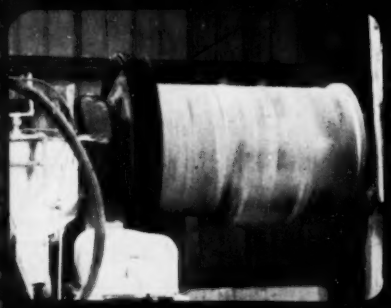
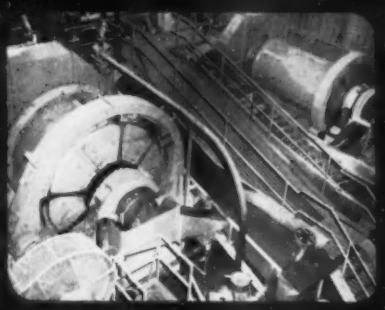


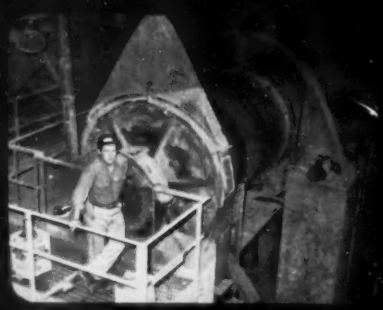
Uranium Reduction Company, Moab, Utah



COG Minerals Corporation, Fry Canyon, Utah



Susquehanna-Western, Riverton, Wyoming



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